Service Guide

SureSigns VS3

Vital Signs Monitor

Release A

English

PHILIPS

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Second Edition

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Vital Signs Monitor

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Text Conventions

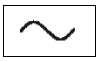
The manual uses the following conventions for Notes, Cautions, and Warnings.

Note	A **Note** calls attention to an important point in the text.
Caution	**A Caution calls attention to a condition or possible situation that could damage or destroy the product or the user's work.**
Warning	**A Warning calls attention to a condition or possible situation that could cause injury to the user and/or patient.**

Explanation of Symbols

The following symbols appear on the monitor and its packaging.

Symbol	Description	Symbol	Description
CE 0123	CE mark		Alarm silence button
Rx Only	Prescription Use Only (US Federal Law)		NBP button
	Humidity		NBP Interval button
	Fragile, handle with care		Main Screen button
	Keep dry		Print button
REF	Catalog number		On/Standby button
	Electrostatic sensitive device handling	LOT	Batch code
2006-06	Date of manufacture		RF Interference
	Keep Upright		Keep out of sun
STERILE	Sterile		NBP connector

Symbol	Description	Symbol	Description
SpO_2	SpO_2 connector	SN	Serial number
	Compliance with WEEE standard		Temperature connector
	Defibrillator proof equipment		Charging LED
ICES-001	Canadian ISM Requirement		AC power LED
	Nurse call connector		Defib Sync Port (unavailable on VS3 monitors)
OPT	Option number		USB port
	Ethernet port	100-240V - 50/60Hz 120VA T 1.6A 250V	Power supply
	CSA mark		Caution, consult accompanying documents
	Ground lug		

Regulatory and Safety Specifications

Declaration

CE

The SureSigns VS3 vital signs monitor is a Class IIb device and complies with the requirements of the Council Directive 93/42/EEC of 14 June 1993 concerning medical devices and carries CE-marking accordingly.

Authorized EU Representative

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Germany

Rx Only

Caution: United States Federal Law restricts this device to sale by or on the order of a physician.

Safety Standards

Parameter	Specification
UL 60601-1, CAN/CSA C22.2 No. 601.1-M90, EN/IEC60601-1 amendments 1 and 2, EN/IEC60601-2-27, IEC60601-1-2:2001, EN12470-3	
Protection Class	Class I, internally powered equipment, per IEC 60601-1
Degree of Protection	Type CF defibrillator-proof: per IEC 60601-1
Mode of Operation	Continuous

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1
Introduction

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Monitor Overview

The SureSigns™ VS3 vital signs monitor is for monitoring, recording and alarming of multiple physiological parameters of adults, pediatrics, and neonates in healthcare environments. Additionally, the monitor is intended for use in transport situations within a healthcare facility.

Configurations

The SureSigns VS3 vital signs monitor is available in several configurations.

Configuration	Product Number
NBP only	863069
NBP and Temperature	863070
NBP and SpO_2	863071
NBP, SpO_2, and Recorder	863072
NBP, SpO_2, and Temperature	863073
NBP, SpO_2, Temperature, and Recorder	863074

All monitor configurations include:

- Battery operation for portability
- 8.4” color screen
- A navigation wheel for quickly changing system settings

2
Installing the Monitor

In This Chapter

- Unpacking 2-2
- Submitting a Damage Claim 2-2
- Repacking 2-2
- Setting up the Monitor 2-2
- Setting up the Optional Barcode Scanner 2-3

Unpacking

To unpack the monitor:

1. Open the shipping container and remove the monitor.
2. Examine the monitor and accessories for visible damage, such as broken components, cables, dents, or scratches on the surface of the equipment.
3. Save the packaging material for possible reuse.

Submitting a Damage Claim

If there is physical damage, or if an item does not meet specified operational requirements, notify the carrier and the nearest Philips Medical Systems Sales/Service office. Philips will arrange for immediate repair or replacement of the damaged or inoperative part.

Repacking

If you ship the components to a Philips Medical Systems Sales/Service office, securely attach a tag showing the name and address of the owner, the component model and serial number, and the repairs (or symptoms of the fault) required.

The original shipping container protects the instrument while in transit.

If the original container is not available or reusable, ask the Philips Sales/Service office to provide information and recommendations on materials and packaging methods.

For more information, see “Returning the Monitor For Service” on page 3-3.

Setting up the Monitor

Setting up the monitor includes:

- Powering up the monitor
- Charging the battery
- Setting the date and time

For information on powering the monitor, charging the power supply battery, and setting the date and time, see the *SureSigns Setup Guide*.

Setting up the Optional Barcode Scanner

The optional barcode scanner can be used to enter Patient ID/Bed ID information. The scanner is preconfigured by Philips for use with the SureSigns VS3 vital signs monitor.

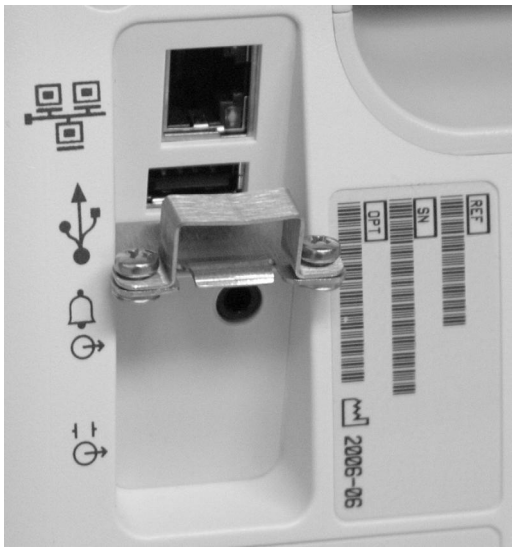
Note—Customization of the scanner may be required for your site. If your site does not use one of the barcode symbologies listed below, contact your local Philips representative for further information.

Note—For best adhesion, the site where the USB clamp is attached must be cleaned thoroughly. Read the SureSigns VS3 Instructions for Use *for proper cleaning instructions.*

Connecting the Scanner

To connect the scanner:

1. Attach the USB clamp to the rear of the monitor as shown, using the clamp's adhesive foam pad.



2. Slide the scanner's USB plug through the clamp and into the port. Once plugged into the USB port (or at monitor startup), the scanner beeps to confirm a successful connection.

3. Use a #1 Phillips-head screwdriver to tighten the two screws on the USB clamp.

The barcode scanner is programmed to read the following symbologies:

- 4-CB (4-State Customer Bar Code)
- Australian Post
- Aztec Code
- British Post
- Canadian Post
- China Post
- Codabar
- Codablock F
- Code 11
- Code 128
- Code 16K
- Code 2 of 5
- Code 39
- Code 49
- Code 93
- Data Matrix
- IATA Code 2 of 5
- Interleaved 2 of 5
- ID-tag (UPU 4-State)
- Kix (Netherlands) Post
- Korea Post
- Matrix 2 of 5
- MaxiCode
- MicroPDF417
- MSI
- PDF417
- Planet Code
- Plessey Code
- PosiCode A and B
- Postnet
- QR Code
- RSS Expanded
- RSS Limited
- RSS-14
- TCIF Linked Code 39 (TLC39)
- Telepen

For information on using the scanner for entering patient data, refer to the *SureSigns VS3 Instructions for Use*.

3
Performing Routine Maintenance

In This Chapter

- Routine Safety and Operational Checks 3-2
- Cleaning 3-2
- Charging the Battery 3-3
- Returning the Monitor For Service 3-3

Routine Safety and Operational Checks

Philips recommends that you perform certain test and verification checks at least every year and after each repair. For complete information on performing verification testing and checks, see Chapter 6, *Performance Verification Testing*.

Philips recommends that you always:

- Visually inspect the monitor exterior for damage
- Inspect monitor labels for legibility

If the labels are not legible, contact the Philips Response Center or your local Philips representative.

Cleaning

Caution **Do not immerse the monitor or its accessories in liquid or clean it with caustic or abrasive cleaners. Do not spray or pour any liquid on the monitor or its accessories.**

To clean the monitor:

1. Dampen a cloth with a commercial, nonabrasive cleaner, and wipe the exterior surfaces lightly.
2. Do not allow liquids to come in contact with the power connector or switches or to penetrate connectors or openings in the monitor.
3. For cables, sensors, and cuffs, follow the cleaning instructions in the *Instructions for Use* that accompany these accessories.

For more detailed information, see the Care and Cleaning chapter in the *SureSigns VS3 Vital Signs Monitor Instructions for Use*.

Charging the Battery

The monitor operates on an 11.1 V Lithium ion, Smart Battery, at 7200 Ah. Battery power lasts a minimum of four hours of continuous monitoring (with no printing), and one NBP measurement every 15 minutes.

A complete battery recharge requires approximately four hours. You can recharge the battery while the monitor is in use. The battery can require a full discharge/charge cycle to restore full capacity.

If the monitor operates for less than one hour on a fully charged battery before the low battery alarm occurs, replace the battery (see Chapter 8, *Repairing the VS3 Monitor*).

Any time the monitor is connected to AC power, the battery is being charged. When you first receive the monitor, the battery charge may be low. Connect the monitor to an AC power source before using it on battery power alone. The Charging LED on the front panel provides the charging status of the battery. The color of the LED indicates how much charge remains on the battery:

- Green: the battery is completely or almost completely charged
- Flashing green: the battery has a medium charge
- Yellow: the battery has a low charge
- Flashing yellow: the battery has almost no charge

The battery status pane on the bottom of the monitor LCD screen also indicates battery status.

Returning the Monitor For Service

If it is necessary to return the monitor for service, call the Philips Response Center or your local Philips representative for a Returned Materials Authorization (RMA) number. Have all equipment serial numbers available when calling. Mark the shipping carton and any shipping documents with the RMA number.

Warning **Before returning any equipment to Philips:**
- **decontaminate it (see "Disposing of the Monitor" on page 3-4)**
- **delete all patient data (see "Clearing All Patient Data" on page 5-15)**

Note—Before servicing the SureSigns VS3 vital signs monitor in your health-care facility, Philips recommends deleting patient data.

To pack the monitor for return, disconnect all cables. It is not necessary to return sensors, the temperature probe, NBP tubing and cuff, or power cord. If available, use the original carton and packing materials.

Ensure that the monitor transports within the following specifications:

Temperature	-20° C to 40° C
Humidity	15% – 90% maximum
Atmospheric Pressure	708 hPa – 1014 hPa (708 mbar – 1014 mbar)

Pack the monitor as follows:

1. Place the monitor and, in necessary, any accessory items in original packaging.
2. Seal the carton with packaging tape.
3. Label the carton with the shipping address, return address, and RMA number.

If the original carton is not available, use the following procedure to pack the monitor:

1. Place the monitor in a plastic bag.
2. Locate a corrugated cardboard shipping carton with at least 200 psi (pounds per square inch) bursting strength.
3. Fill the bottom of the carton with at least 2 inches of packing material.
4. Place the bagged unit on the layer of packing material and fill the box completely with packing material.
5. Seal the carton with packaging tape.
6. Label the carton with the shipping address, return address, and RMA number.

Disposing of the Monitor

To avoid contaminating or infecting personnel, the environment, or other equipment, disinfect and decontaminate the monitor appropriately before disposing of it in accordance with your country's law for equipment containing electrical and electronic parts.

For disposal of parts and accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.

Note—Before disposing of a SureSigns VS3 vital signs monitor, delete all patient information. To delete patient data from the monitor, see "Clearing All Patient Data" on page 5-15.

4
Networking and Interfacing

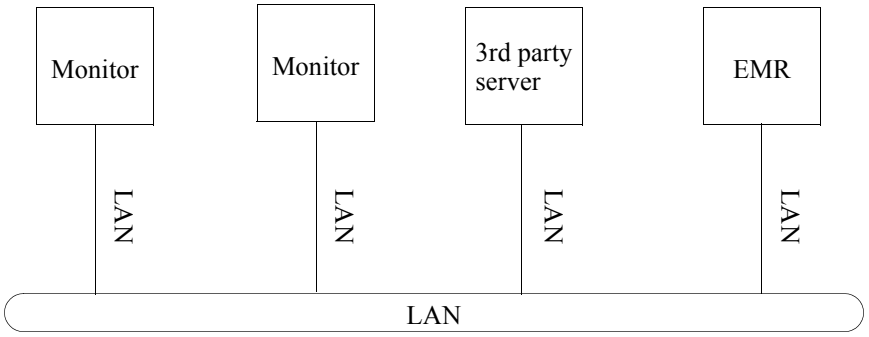
In This Chapter

- Interfacing 4-2
- Configuring Network Settings 4-3

Overview

The SureSigns VS3 vital signs monitor includes data export capability. The monitor can export data in HL7 format via TCP/IP over Ethernet links to a server. The server stores the data or can forward it to the hospital electronic medical record (EMR) system. You use the ethernet port on the back of the monitor for Ethernet connections.

The following figure shows an example of a typical Ethernet configuration.



Caution **Philips recommends that the server on which patient data is stored is kept in a secure location.**

Interfacing

You can specify the interval in which the monitor attempts to connect to the server to export data. When a connection is established, the monitor displays a connection icon in the middle of the left side of the screen.

The monitor exports the following:

- All new patient records from the database that have not been exported
- All new alarm records that have not been exported

You can also encrypt the exported data using the algorithm and encryption key. This encryption key must reside on the monitor and on the server. Details about the HL7 output and related interfacing information are contained in the *SureSigns HL7 Guide*. If you need a copy of this guide, contact your Philips representative.

Configuring Network Settings

You configure the network settings with the **System Admin** Menu. The menu lets you configure the IP address used for HL7 data exchange, data export interval, and encryption keys. For information on using the **System Admin** Menu to configure the network settings, see “Configuring the Network and Exporting Data” on page 5-12.

For more detailed information, see the *SureSigns HL7 Guide*.

5
Configuring the Monitor

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- Setting the Alarm Tone Pattern 5-5
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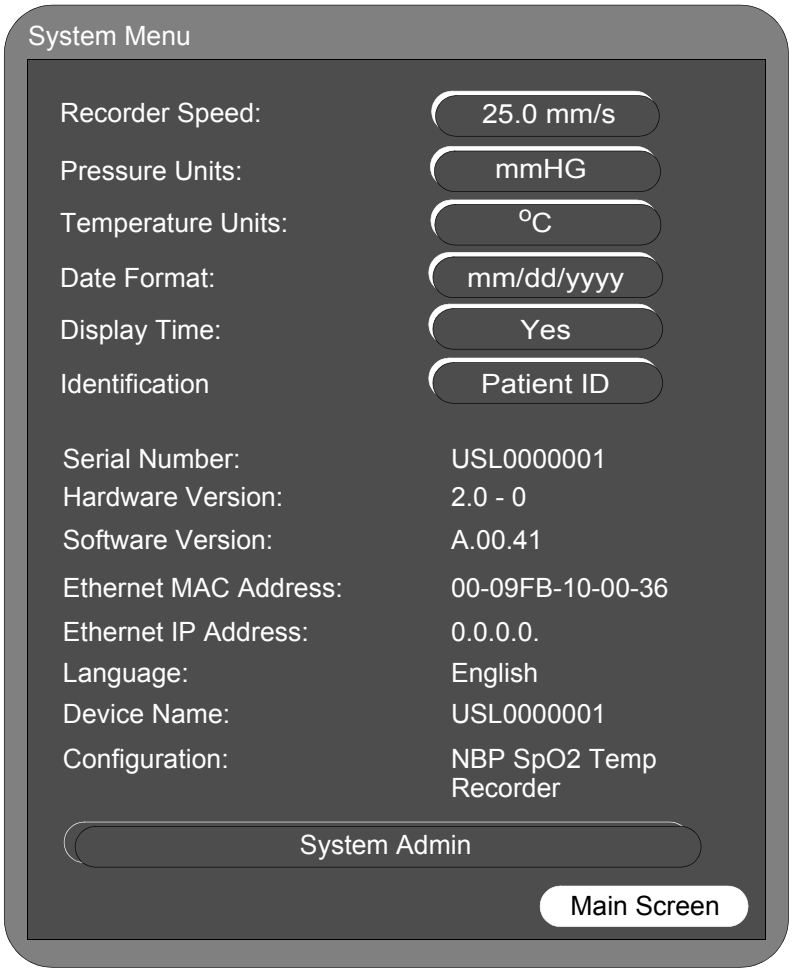
Accessing the System Admin Menu

Use the **System Admin** section of the **System Menu** to configure monitor-wide default settings and parameters.

To access the **System Admin** menu:

1. Rotate the wheel until the **System** icon is highlighted, then press the wheel.

The **System Menu** appears.

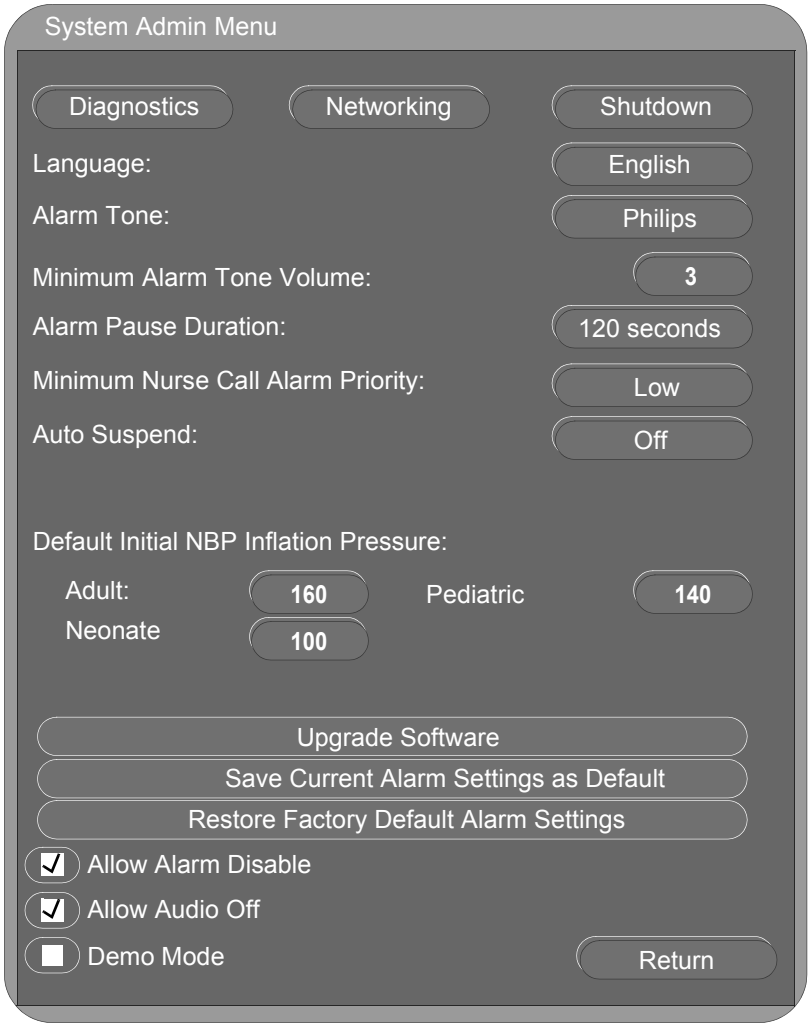


2. For information on using the **System Menu** to set recorder speed, units, date format, display time, and identification method, see the *SureSigns VS3 Vital Signs Monitor Instructions for Use*.
3. Rotate the wheel until the **System Admin** button is highlighted, then press the wheel.

A **Password** window appears.

4. Enter the Administrator password (2-1-5) by turning the wheel until the first box is highlighted, then pressing the wheel. Rotate the wheel to select the first digit, then press the wheel to save the digit. Repeat this for the next two digits of the password.
5. Rotate the wheel until the **OK** button is highlighted, then press the wheel.

The **System Admin** Menu appears.



Caution **During system configuration, the System Admin Menu remains unlocked for 1 minute after you close it. This allows you to open the menu again without having to re-enter the password. Do not leave the monitor unattended during the *unlock* time.**

6. Use this menu to set system parameters. The following section "System Admin Menu Options" shows all available options.

System Admin Menu Options

The following table describes all of the buttons in the **System Admin Menu** and the default settings.

Button	Description	Default
Diagnostics	Opens the **System Diagnostics** menu. Monitoring is suspended while this menu is open. Note that this button is unavailable when the monitor is running in Demo mode.	—
Networking	Opens the **Network Configuration** menu.	—
Shutdown	Shuts down the monitor (for battery change) after you press **OK** in the confirmation window.	—
Language	Specifies which language the monitor displays. Changing the language setting opens a confirmation window; pressing **OK** reboots the monitor. Options are: English, Spanish, German, French, Italian, Dutch, Portuguese.	Depends on country
Alarm Tone	Specifies the type of alarm tones that the monitor uses. Options are: Philips, IEC.	Philips
Minimum Alarm Tone Volume	Specifies the minimum alarm tone volume to which you can set the monitor. Options are 1-10.	3
Alarm Pause Duration	Specifies the amount of time for which alarms do not sound when alarms are paused by the user. Options are: 30, 60, 90,120, 180 sec.	120 sec
Minimum Nurse Call Alarm Priority	Specifies the minimum alarm level that triggers the nurse call signal. e.g., if the value is set to Medium, then Medium and High priority alarms will trigger the nurse call signal, but Low will not. Options are: Low, Medium, High.	Low
Auto Suspend	Specifies that the monitor suspend power to the display and peripherals after a period of inactivity. Press the Power button to end the suspension and turn the display and peripherals back on. Note that this setting is unavailable during either NBP Auto Interval or Interval Program periods. Options are: Off, 5, 10,15, 30 minutes	Off
Default Initial NBP Inflation Pressure: Categories: Adult Pediatric Neonate	Specifies the default cuff inflation pressure for NBP. Options are: 80-240 mmHg, 20 mmHg steps 80-240 mmHg, 20 mmHg steps 60-120 mmHg, 20 mmHg steps	 160 mmHg 140 mmHg 100 mmHg
Upgrade Software	Opens the confirmation window for upgrading the monitor software.	—

Button	Description	Default
Save Current Alarm Settings as Default	Specifies that the monitor use the current alarm settings as the default settings.	—
Restore Factory Default Alarm Settings	Specifies that the monitor use the factory alarm settings as the default settings.	—
Allow Alarm Disable	Checking this box allows a user to disable alarms.	Checked
Allow Audio Off	Checking this box allows a user to turn off the alarm audio.	Checked
Demo Mode	Demo Mode allows the monitor to be demonstrated without actually monitoring parameters. Checking this box activates demo mode.	Unchecked
Return	Returns the monitor to the System menu.	—

Selecting a Language

You can configure a variety of languages on the monitor. To change the language:

1. Open the **System Admin** section of the **System** menu. See “Accessing the System Admin Menu” on page 5-2.
2. Rotate the wheel until **Language** is highlighted.
3. Press the wheel, then rotate it to select the language in which you want to use the monitor.
4. Press the wheel again to save the setting.

A confirmation window appears warning that to change the language, the system must reboot.

5. In the confirmation window, rotate the wheel to **Yes**, then press the wheel to change the language and reboot the system.

Setting the Alarm Tone Pattern

The Alarm Tone setting controls the pattern of audible sounds during alarms. To set the alarm tone:

1. Open the **System Admin** section of the **System** menu. See “Accessing the System Admin Menu” on page 5-2.
2. Rotate the wheel until **Alarm Tone** is highlighted.
3. Press the wheel, then rotate it to select the default setting for alarm tone.
4. Press the wheel again to save the setting.
5. Press the **Main Screen** button on the front panel to close the menu.

Setting the Minimum Alarm Tone Volume

You can configure the alarm volume to control the minimum volume that a user can set on the monitor. To set the minimum alarm tone volume:

1. Open the **System Admin** section of the **System** menu. See “Accessing the System Admin Menu” on page 5-2.
2. Rotate the wheel until **Minimum Alarm Tone Volume** is highlighted.
3. Press the wheel, then rotate it to select the minimum alarm tone volume that a user can set.
4. Press the wheel again to save the setting.
5. Press the **Main Screen** button on the front panel to close the menu.

Setting the Alarm Pause Duration

Alarm Pause mode disables audible alarm notification for all current and future alarms for a configured time. If the user presses the **Alarm Silence** button twice in two seconds, Alarm Pause mode activates, and a small banner appears in the center of the screen. This banner displays the message “Audio Paused”, and counts down the remaining seconds until Alarm Pause mode ends.

When Alarm Pause ends, all current alarms become audible (except technical alarms), even if previously silenced before entering Alarm Pause mode. When alarms are paused, the nurse call signal does not alarm. This does not affect other alarm indication methods.

To configure the duration for which alarms are paused during alarm pause mode:

1. Open the **System Admin** section of the **System** menu. See “Accessing the System Admin Menu” on page 5-2.
2. Rotate the wheel until **Alarm Pause Duration** is highlighted.
3. Press the wheel, then rotate it to select the default setting for alarm pause duration.
4. Press the wheel again to save the setting.
5. Press the **Main Screen** button on the front panel to close the menu.

Setting the Minimum Nurse Call Alarm Priority

The nurse call signal is a physical connection on the monitor that can connect to a variety of external signals; for example, lights, alarm buzzers, or paging systems. When any alarm condition exists, the nurse call signal activates.

You can configure the alarm priority that triggers the nurse call signal. Pausing (or turning off) alarms, turns off the nurse call signal. The nurse call alarm priority is the minimum alarm priority level that triggers the nurse call signal; this value is *inclusive*. In other words, if the value is set to medium, then anything other than a low priority alarm triggers the nurse call signal.

To configure the nurse call alarm priority:

1. In the **System Admin** menu, rotate the wheel until **Minimum Nurse Call Alarm Priority** is highlighted.
2. Press the wheel, and then rotate it to select Low, Medium, or High priority.
3. Press the wheel to save the selected priority.
4. Press the **Main Screen** button on the front panel to close the menu.

Changing the Initial NBP Pressure

You can specify the initial NBP inflation pressure value for Adult, Pediatric, and Neonatal patients. The monitor uses this default value for new patient starts. When the monitor is using Interval mode, the cuff inflates to the **Initial NBP Inflation Pressure** setting for the first NBP measurement, and then the monitor adjusts the inflation value based on the patient's Systolic measurement.

To change the initial NBP inflation pressure:

1. Open the **System Admin** section of the **System** menu. See "Accessing the System Admin Menu" on page 5-2.
2. Rotate the wheel until the **Default Initial NBP Inflation Pressure** menu is highlighted.
3. Press the wheel and rotate it to select the initial NBP cuff inflation pressure.
4. Press the wheel to save the settings.
5. Press the **Main Screen** button on the front panel to close the menu.

Setting the Auto Suspend Period

To save battery power, you can set the monitor to suspend power to the display and peripherals after a period of inactivity. To end the suspension, press the Power button.

Note—The Auto Suspend function only works when the monitor is running on battery power, when the NBP Auto Interval mode and Interval Programs are Off, and there are no ongoing measurements.

1. Open the **System Admin** section of the **System** menu. See "Accessing the System Admin Menu" on page 5-2.
2. Rotate the wheel until **Auto Suspend** is highlighted.
3. Press the wheel, then rotate it to select the time after which the monitor automatically goes to sleep.
4. Press the wheel to save the settings.
5. Press the **Main Screen** button on the front panel to close the menu.

Performing Software Upgrades

Caution **Charge the battery before upgrading the software. Once the upgrade starts:**
- **do not unplug the monitor**
- **do not remove the USB upgrade memory module**
- **do not press any keys**

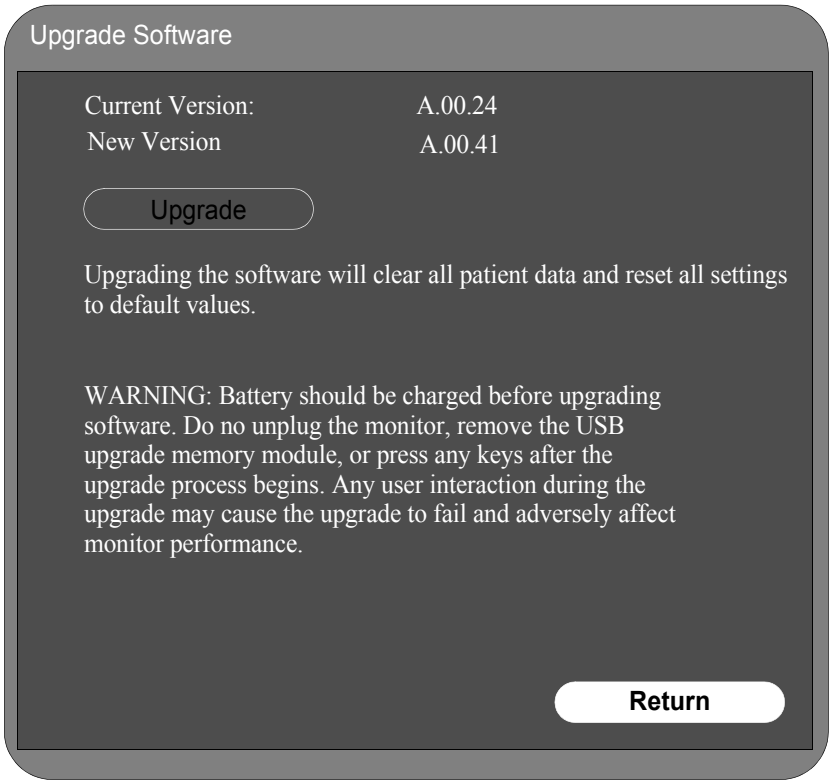
Touching the monitor during the upgrade can affect monitor performance.

Caution **Upgrading the software will clear all patient data and reset all settings to factory default values.**

To perform a software upgrade:

1. Connect the monitor to AC power and turn the unit on.
2. Insert the USB memory stick with the software upgrade into the USB port on the back of the monitor.
3. Open the **System Admin** section of the **System** menu. See "Accessing the System Admin Menu" on page 5-2.
4. Rotate the wheel to highlight the **Upgrade Software** button, then press the wheel.

The monitor looks for a valid software image on the USB memory stick, and displays the software image information in the **Upgrade Software** window.


Upgrade Software
Current Version: A.00.24
New Version A.00.41
Upgrade
Upgrading the software will clear all patient data and reset all settings to default values.
WARNING: Battery should be charged before upgrading software. Do no unplug the monitor, remove the USB upgrade memory module, or press any keys after the upgrade process begins. Any user interaction during the upgrade may cause the upgrade to fail and adversely affect monitor performance.
Return

If the monitor cannot find a valid software image, the screen returns to the **System Admin** menu.

Caution **If a loss of power interrupts the upgrade progress, the monitor cannot boot. If this happens, contact the Response Center or a Philips representative.**

5. Rotate the wheel to highlight the **Upgrade** button and press it to start the upgrade.

The "Upgrade in Progress" indicator increments while the upgrade is in progress. When the upgrade is complete, the *Checking Memory CRC* and *Upgrade Successful* messages appear. The monitor then automatically shuts itself down and reboots.

6. Remove the memory stick.

Changing the Default Alarm Settings

You can change the monitor's default alarm settings. The monitor is able to set the current user-defined alarm settings as new default settings, or to restore the factory settings. The following table lists the factory alarm settings.

To set the default alarm setting (or restore the factory default alarm settings):

1. Open the **System Admin** section of the **System** menu. See "Accessing the System Admin Menu" on page 5-2.
2. Rotate the wheel until either the **Save Current Alarm Settings as Default** or **Restore Factory Default Alarm Settings** button is highlighted, then press the wheel to save the setting.

The monitor displays a confirmation window.

3. In the **Confirmation** window, rotate the wheel to select **Yes**, then press the wheel again.

The monitor now takes this setting (current or factory settings) as the default alarm setting value. The following table shows these alarm settings.

4. Press the **Main Screen** button on the front panel to close the menu.

Factory Default Alarm Limits

The following table lists the factory default alarm limits.

	Adult		Pediatric		Neonatal	
	High	**Low**	**High**	**Low**	**High**	**Low**
Heart Rate	120 bpm	50 bpm	160 bpm	75 bpm	200 bpm	100 bpm
SpO_2	100%	90%	100%	90%	95%	85%
NBP Systolic	160 mmHg (21.3 kPa)	90 mmHg (12.0 kPa)	120 mmHg (16.0 kPa)	70 mmHg (9.3 kPa)	90 mmHg (12.0 kPa)	40mmHg (5.3 kPa)
NBP Diastolic	90 mmHg (12.0 kPa)	50 mmHg (6.7 kPa)	70 mmHg (9.3 kPa)	40 mmHg (5.3 kPa)	60 mmHg (8.0 kPa)	20 mmHg (2.7 kPa)
NBP MAP (Mean)	110 mmHg (14.7 kPa)	70 mmHg (9.3 kPa)	90 mmHg (12.0 kPa)	50 mmHg (6.7 kPa)	70 mmHg (9.3 kPa)	24 mmHg (3.2 kPa)
Temperature	102.2°F 39°C	96.8°F 36°C	102.2°F 39°C	96.8°F 36°C	102.2°F 39°C	96.8°F 36°C

Disabling Audio and Alarms

You can control whether a user can disable alarms and/or turn off the audio. To set this:

1. Open the **System Admin** section of the **System** menu. See “Accessing the System Admin Menu” on page 5-2.
2. Rotate the wheel until the **Allow Alarm Disable** or **Allow Audio Off** checkbox is highlighted.
3. Press the wheel to insert a check in the box to allow a user to disable alarms or turn off the audio.
4. Press the **Main Screen** button on the front panel to close the menu.

Setting Demo Mode

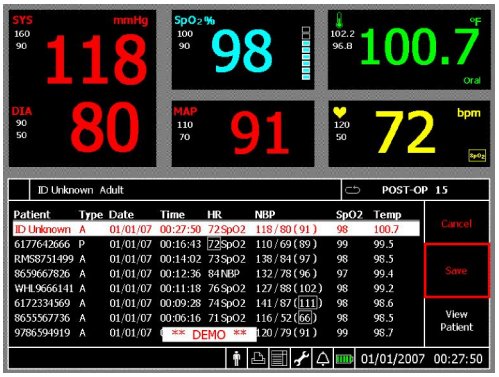
Demo mode lets you demonstrate the monitor without monitoring parameters. Demo mode simulates all patient parameters, including NBP. Demo mode generates alarms when alarm settings are exceeded. Entering demo mode always clears patient data.

Warning **Do not connect a patient to the monitor running in Demo mode. Values represented in Demo mode do not represent measurements from a patient connected to the monitor, and may lead to incorrect diagnoses.**

1. Open the **System Admin** section of the **System** menu. See “Accessing the System Admin Menu” on page 5-2.
2. Rotate the wheel until the Demo Mode checkbox is highlighted and press the wheel to insert a check in the Demo Mode box.
3. Rotate the wheel to highlight **Return** and press the wheel to select it.

A confirmation window asks if you want to enter demo mode and clear all patient data.

4. In the **Confirmation** window, rotate the wheel to **Yes**, and press the wheel again to select it. Demo mode activates, the monitor clears all patient data, and a small DEMO banner appears at the bottom of the screen.



5. To exit **Demo Mode**, press the **Power** button to turn the monitor off.

Configuring the Network and Exporting Data

The **Network Configuration** menu controls how the monitor connects to a network and how data is exported in HL7 format. For more information on the communications protocol, see the *SureSigns HL7 Guide*.

Note—It is the users' responsibility to set appropriate security levels to protect patient data in accordance with HIPAA standards.

To configure the network and enable data export settings:

1. Rotate the navigation wheel until the System icon is highlighted, then press the wheel.

The **System Menu** appears.

2. Rotate the wheel until the **System Admin** button is highlighted, then press the wheel.

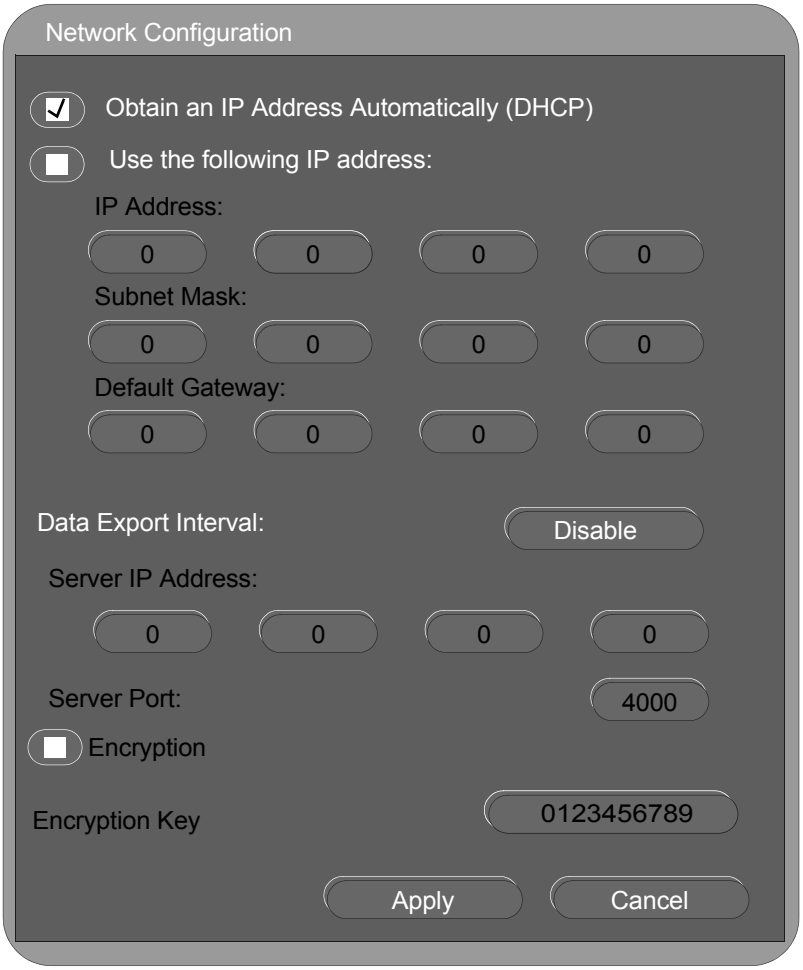
A **Password** window appears.

3. Enter the Administrator password (2-1-5) by turning the navigation wheel until the first box is highlighted, then pressing the wheel. Turn the wheel to select the first digit, then press the wheel to save the digit. Repeat this for the next two digits of the password.
4. Rotate the wheel until the **OK** button is highlighted, then press the wheel.

The **System Admin** Menu appears.

5. Rotate the wheel until the **Networking** button is highlighted, then press the wheel.

The **Network Configuration** menu appears.



6. Specify an IP address for the monitor:
   - **To obtain an IP address from a DHCP server,** select the **Obtain an IP Address Automatically (DHCP)** checkbox;
   - **To assign a specific IP address**, select the **Use the following IP address** checkbox, and then use the navigation wheel to manually enter an **IP Address**, **Subnet Mask**, and **Default Gateway**.
7. Rotate the wheel until the **Data Export Interval** field is highlighted. Select the desired export interval. After you select an interval time, the **Server IP Address** fields become available.
8. Rotate the wheel to enter the **Server IP Address**.
9. Rotate the wheel to highlight the **Server Port** field. Enter the port number for the server. The default value is 4000.
10. Optionally, select the **Encryption Key** checkbox, and press the wheel. A keyboard appears.
11. Use the wheel to specify the encryption key. Press the "**<-**" key to backspace, **Cancel** to close the keyboard without saving, or **OK** to save the changes.
12. Rotate the wheel to highlight the **Apply** button, then press the wheel to save the changes.

If you changed the IP address, a **Reboot** window appears. Select **OK** to reboot the system.

Resetting a Serial Number

When you replace the main PCB, you must reset the unit's serial number. The serial number appears in a label (marked SN) on the back of the monitor.

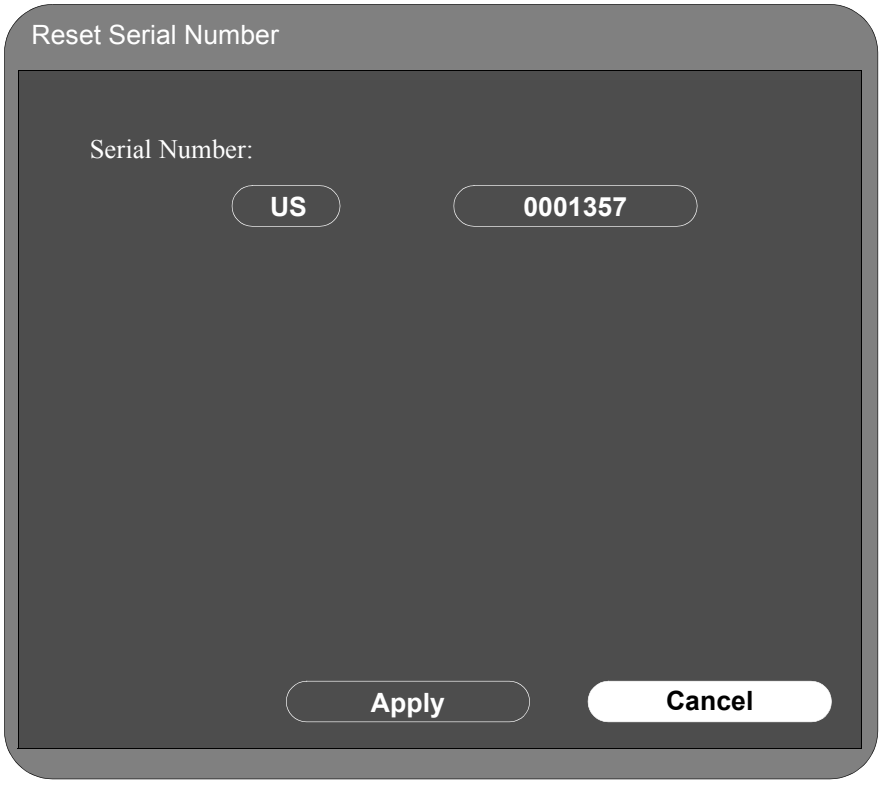
To reset a serial number:

1. Open the **System Admin** section of the **System** menu. See "Accessing the System Admin Menu" on page 5-2.
2. Rotate the wheel until the **Diagnostics** button is highlighted, then press the wheel. The **System Diagnostics** menu appears.
3. Select the **Maintenance >>** button and press the wheel.

A **Password** window appears.

4. Enter 1-2-9 in the **Password** window.
5. The complete **System Diagnostics** menu, including **Maintenance**, appears.
6. Turn the wheel to highlight the **Reset S/N** button, then press the wheel.

The **Reset Serial Number** menu displays.



7. Rotate the wheel to the country menu, and push the wheel.
8. Rotate the wheel to select either China (CN) or United States (US), then push the wheel to save the setting.
9. Rotate the wheel to the serial number button, then push the wheel.

A keyboard appears.

10. Use the wheel to specify the serial number. Press the "<-" key to backspace, **Cancel** to close the keyboard without saving, or **OK** to save the changes.
11. Click the **Apply** button in the **Reset Serial Number** window to save the change.

A system reboot confirmation window appears.

12. In the confirmation window, rotate the wheel to select **Yes**.

Clearing All Patient Data

Resetting the system clears all memory and patient data, except for calibration and hardware configuration data. When you reconfigure a system, you should reset the system first.

To clear all patient data:

1. In the **System Diagnostics** menu, rotate the wheel to highlight the **Clear Data** button, then press the wheel.

A confirmation window confirms that the system is about to clear all patient data and restart the system.

2. Rotate the wheel to select **Yes**, and press the wheel.

The monitor reboots and resets the system.

Setting the System Configuration

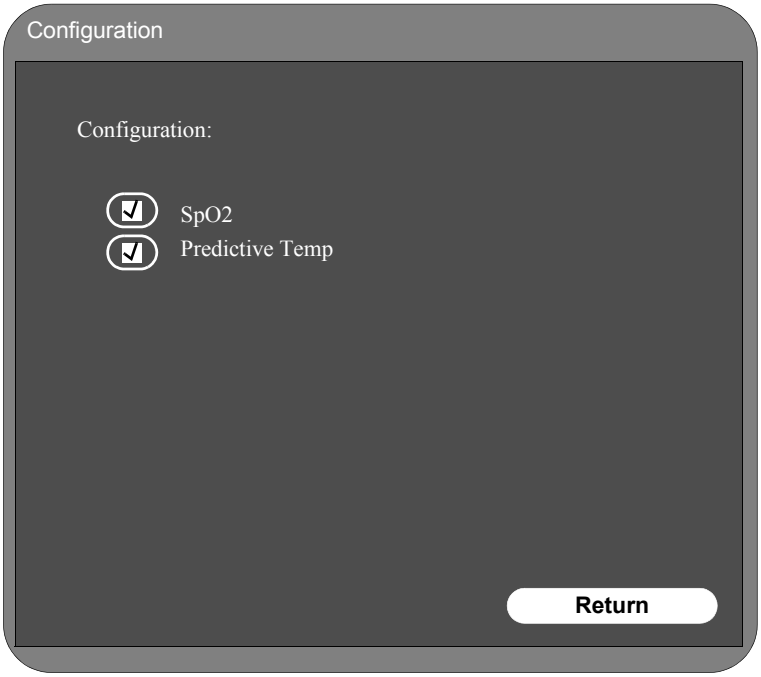
When the monitor performs a self test, it first checks its system configuration. If you replace the main PCB in the unit, then you must reprogram the system configuration. You can configure the monitor for Predictive Temperature or for SpO_2.

Caution	**The system configuration settings must match the hardware installed on the monitor. Incorrect settings may result in damage to the monitor.**

To reset the system configuration:

1. In the **System Diagnostics** menu, rotate the wheel to highlight the **Configuration** button, then press the wheel.

The **Configuration** menu appears, for example:



2. Rotate the wheel and press it to place a checkmark by each option in the monitor.
3. To save these settings to the main PCB, rotate the wheel to the **Return** button.

A confirmation window appears advising that the system will reboot.

In the confirmation window, rotate the wheel to select **Yes** and press the wheel. The monitor reboots.

Resetting the Barcode Scanner

The barcode scanner's programming can be reset to Philips' default settings.

Note—You must perform a hard shutdown after resetting the barcode scanner; see "Performing a Hard Shutdown" on page 5-17.

To reset the scanner:

1. Print this page.
2. Scan the following barcode:

3. When the barcode is processed, the scanner beeps to indicate that the programming has been reset to Philips' default settings.
4. Shut down the monitor as explained in "Performing a Hard Shutdown" on page 5-17.

Performing a Hard Shutdown

Perform a hard shutdown whenever you need to power down for a battery change. This ensures that all patient and system data is saved in memory.

To perform a hard shutdown:

1. Open the **System Admin** section of the **System** menu. See "Accessing the System Admin Menu" on page 5-2.
2. Rotate the wheel until the **Shutdown** button is highlighted and press the wheel.

A confirmation window asks if you want to shut down the system.

3. In the **Confirmation** window, answer **Yes**.

The system shuts down.

6
Performance Verification Testing

In This Chapter

- Testing and Inspection Guidelines 6-2
- Recommended Frequency 6-3
- Test Recording 6-4
- Required Test Equipment 6-5
- Performing Verification Tests 6-5
- Visual Test 6-5
- Power-On Self Test 6-6
- Alarms Testing 6-6
- Sp02 Tests 6-6
- NBP Test 6-8
- Temperature 6-11
- Safety Tests 6-12
- Battery Maintenance and Indicators 6-15
- Nurse Call Relay Test 6-17
- Barcode Scanner Test 6-18

Overview

This chapter describes how to test the monitor following repairs or during routine maintenance. If the monitor fails any test, it must be repaired before it is returned to use. This chapter also includes information on testing and inspection guidelines and recommended frequency.

Important—Many of the test procedures in this chapter assume knowledge of how to use the monitor. For details on using the monitor and its various menus, see the SureSigns VS3 Vital Signs Monitor Instructions for Use.

Testing and Inspection Guidelines

The following table lists the tests that Philips requires that you complete after performing monitor installations, repairs, or software upgrades. See Chapter 3, *Performing Routine Maintenance*, for information on routine maintenance. See Chapter 8, *Repairing the VS3 Monitor*, for information on repair procedures.

After …	Complete These Tests …
Installing or exchanging a monitor	Visual inspection Power-on
Upgrading the software	Visual inspection Power-on
Opening the monitor for any reason	Power-on Pneumatic leakage All safety tests
Replacing any internal parts (except NBP parts, SpO_2 board)	Power-on Pneumatic leakage All safety tests
Replacing the NBP module or parts	Power-on NBP test Pneumatic leakage All safety tests
Replacing the SpO_2 board	Power-on SpO_2 Pneumatic leakage All safety tests

Recommended Frequency

Perform the test procedures at the recommended frequency outlined in the following table.

Caution The frequency recommendations in the following table do not supersede local requirements. Always perform locally required testing in addition to the testing outlined in the table.

Suggested Testing	Frequency
Performance	
• Temperature accuracy • NBP accuracy test • SpO_2 • Nurse call relay*	Once every year, or if you suspect the measurement is incorrect.
Safety In accordance with IEC 60601-1	
• System enclosure leakage current • Ground integrity • Patient leakage current	Once every year or after repairs where the unit has been opened (front and back separated) or the monitor has been damaged by impact.

*When used as part of facility protocols

Test Recording

Authorized Philips personnel report test results back to Philips to add to the product development database. Hospital personnel, however, do not need to report results.

The following table describes what to record on the service record after you complete the tests in this chapter.

Note: P = pass, F = fail, X = measured value as defined in tests in this chapter

Test	What to record
Visual	V:P or V:F
Power-On	PO:P or PO:F
NBP	NBP:P/X1/X2/X3 or NBP:F/X1/X2/X3
Safety	S(1):P/X1/X2 or S(1):F/X1/X2 S(2): P/X1 or S(2): F/X1 S(3): P/X1 or S(3): F/X1

Required Test Equipment

The following table lists the additional test equipment that you need to perform each of the tests in this chapter. Many of these tests also use the standard accessories that are shipped with the monitor.

To Perform This Test …	You Need This Test Equipment …
"Visual Test" on page 6-5	None
"Power-On Self Test" on page 6-6	None
"Alarms Testing" on page 6-6	• Adult SpO_2 transducer
"Sp02 Tests" on page 6-6	• Adult SpO_2 transducer
"NBP Test" on page 6-8	• Reference manometer (includes hand pump and valve), accuracy 0.2% of reading • Expansion chamber (volume 250 ml +/- 10%) • Appropriate tubing
"Temperature" on page 6-11	• SureSigns temperature CalKey (part # 4535 640 33691)
"Safety Tests" on page 6-12	• Multimeter
"Battery Maintenance and Indicators" on page 6-15	None
"Nurse Call Relay Test" on page 6-17	• Patient simulator • Ohmmeter • Phono connector

Performing Verification Tests

You perform some verification tests using the **Diagnostics** menu that you access by clicking on the system tools icon on the monitor screen. For more information on accessing the system diagnostics to perform verification tests, see the section "Running System Diagnostics" on page 7-23.

Visual Test

To perform the visual test:

1. Inspect the system for obvious signs of damage; for example, cracks, cuts, or breakage.
2. Check all external cables and accessories; for example, cuts, kinks, wrong connections.
3. Check that the fuse is the correct value after replacing (see "Removing a Power Connector Fuse" on page 8-6)
4. Ensure that all markings and labeling are legible.

5. Check for any obstructions to mechanical parts.

The expected test result is that the system has no obvious signs of damage or obstruction.

Power-On Self Test

To perform the power-on self test:

1. Plug the monitor into an AC power source and turn it on.
2. Make sure that the monitor boots up successfully and displays the monitoring main screen.

The expected result is that the monitor boots up and displays the monitoring main (or appropriate) screen. For detailed information on the boot and power sequences, see "Boot and Power Sequences" on page 7-4.

Alarms Testing

To verify that the general monitor alarms are working, test them while using the NBP monitoring function.

To test the monitor alarm:

1. With the monitor turned on, make sure that all alarms are enabled (the monitor is not in Audio Pause or Audio Off mode).
2. Make sure the NBP alarm is enabled (the crossed bell icon does not appear in the NBP numeric pane).
3. Connect the NBP hose to the NBP input connector, but do not place the cuff on your arm.
4. Press the NBP button on the front panel.
5. Check that the NBP Timeout or NBP Loose Cuff message appears and an alarm tone sounds.
6. If you do not get the results in Step 5, see Chapter 7, *Troubleshooting*.

$Sp0_2$ Tests

Before you Start: See "Required Test Equipment" for a list of the equipment that you need to perform this test.

This test checks the performance of the SpO_2 measurement and alarm:

1. Connect an adult SpO_2 transducer that you know to be working correctly to the SpO_2 connector on the monitor. Ensure that the red LED in the sensor in the transducer is lit.
2. Connect the other end of the transducer to your finger (this assumes that you are healthy).
3. Verify that the SpO_2 value displayed on the monitor is between 95% and 100%. If it is not, try the test again with a patient simulator.
4. If you still do not get the results in Step 3, see Chapter 7, *Troubleshooting*.

Caution **The SpO2 accuracy has been validated in human studies against arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed. Only about two-thirds of the measurements can be expected to fall within the specified accuracy compared to CO-oximeter measurements.**

Display Update Period: typically 2 seconds
Maximum: 30 seconds
Max. with NBP INOP suppression on: 60 seconds

A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor. However, if there is independent demonstration that a particular calibration curve is accurate for the combination of a pulse oximeter monitor and a pulse oximeter sensor, then a functional tester can measure the contribution of a monitor to the total error of a monitor/sensor system. The functional tester can then measure how accurately a particular pulse oximeter monitor is reproducing that calibration curve.

NBP Test

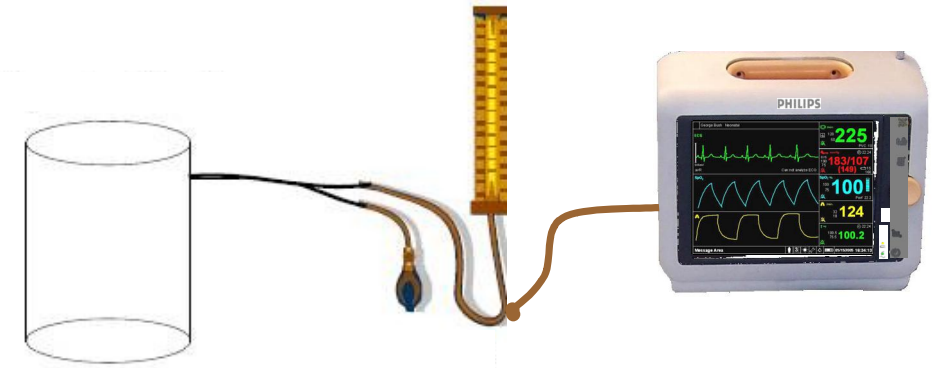
Before you Start: See “Required Test Equipment” for a list of the equipment that you need to perform this test.

These tests check the performance of the non-invasive blood pressure measurement. Perform each of these NBP checks and procedures when checking the NBP unit:

- NBP accuracy
- NBP calibration procedure (if required)
- NBP pneumatic leakage
- NBP overpressure valve

NBP Accuracy

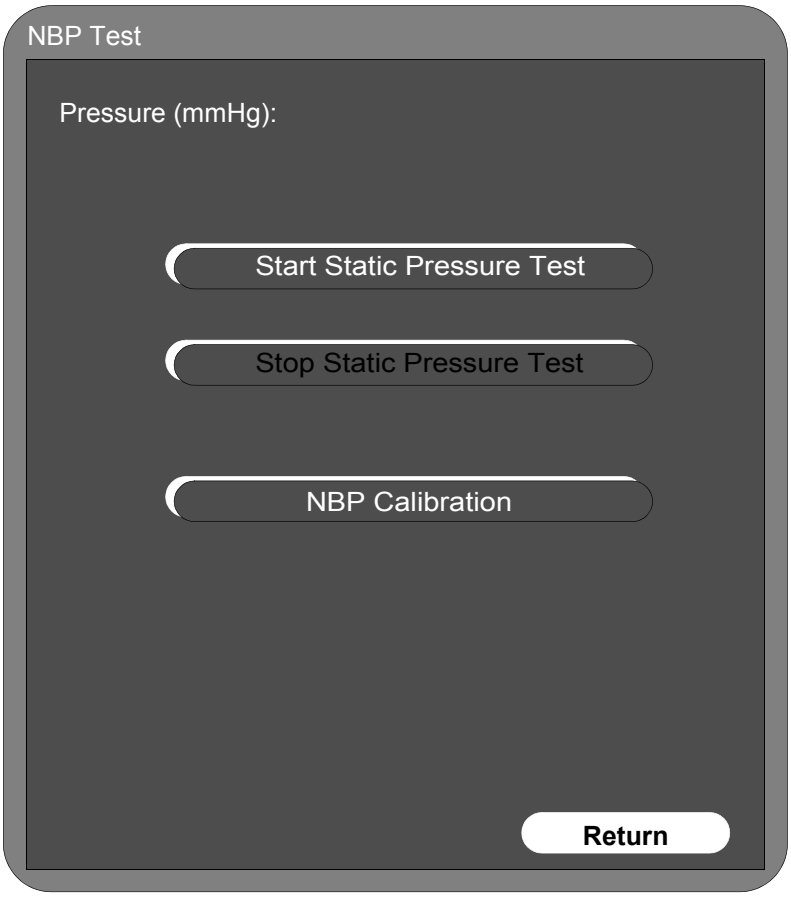
1. Connect the manometer and the pump with tubing to the NBP connector.
2. Connect the tubing to the expansion chamber (500ml cylinder).



Expansion chamber **Manometer** **Monitor**

1. Open the **Maintenance** menu (see “Running System Diagnostics” on page 7-23 for information on opening the **Maintenance** menu).
2. Turn the wheel to highlight **NBP Test**, then press the wheel**.**

The **NBP Test** window appears.



3. Rotate the wheel to highlight the **Start Static Pressure Test** button and press the wheel to start the test.
4. Squeeze the manometer pump and apply a pressure of 50mmHg.
5. Note the pressure displayed in the **NBP Test** window and record this result as **X1** (see "Test Recording" on page 6-4). It should be 50mmHg +/- 3mmHg.
6. Squeeze the manometer pump to apply a pressure of 250mmHg to the monitor.
7. Note the pressure displayed in the **NBP Test** window and record this result as **X2**. The pressure in the **NBP Test** window should be 250mmHg +/- 3mmHg.
8. Press the **Stop Static Pressure Test** button to stop the test.
9. If the difference between the manometer and displayed values is greater than 3mmHg, calibrate the monitor (see "NBP Calibration Procedure" on page 6-10). If not, skip to the "Pneumatic Leakage Test" on page 6-11.

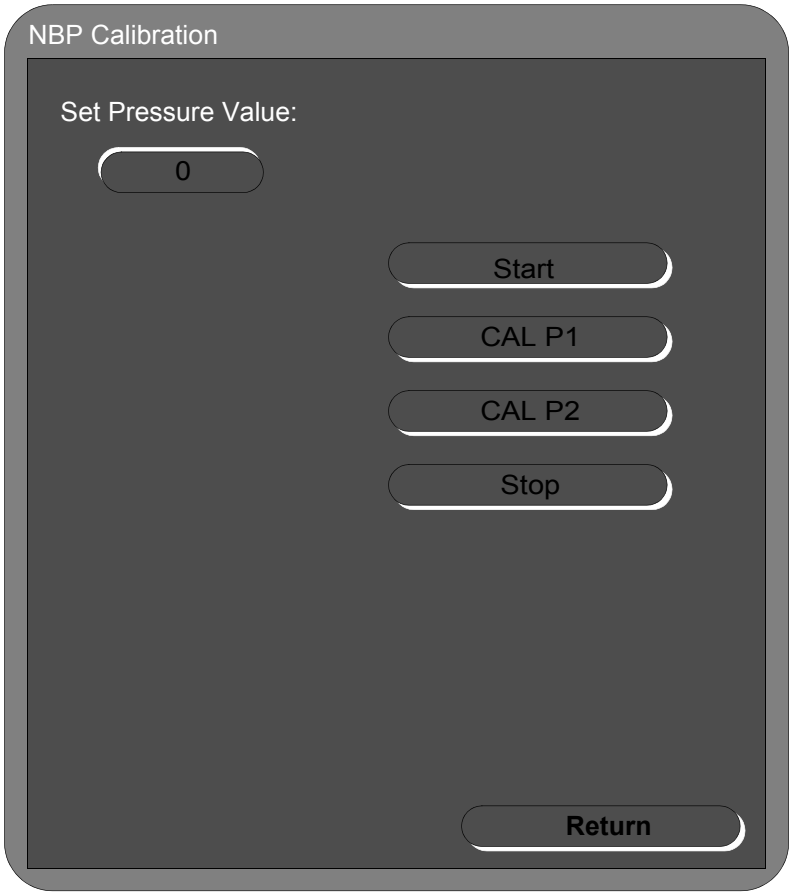
NBP Calibration Procedure

To calibrate the NBP module:

1. Rotate the wheel to select **NBP Calibration** in the **NBP Test** window, then press the wheel to start the process.

Note—To stop the calibration process at any time, rotate the wheel to select **Stop,** then press the wheel to stop calibration.

The **NBP Calibration** window appears.



2. Rotate the wheel to highlight the **Start** button**,** and press the wheel to begin calibration.
3. Squeeze the manometer pump to apply a pressure of 250mmHg to the monitor.
4. In the **NBP Calibration** window, rotate the wheel to the **Set Pressure Value:** menu and press the wheel. Rotate it to 250, then press the wheel to save the value.
5. Rotate the wheel to **CAL P1,** then press the wheel to save this as the first calibration point.
6. Release the pressure in the manometer to 50mmHg.
7. In the **NBP Pressure** window, rotate the wheel to the **Set Pressure Value** menu, then press the wheel and rotate it to 50, and press the wheel to save the setting.

8. Rotate the wheel to select **CAL P2,** and press the wheel to save this as the second calibration point.
9. Rotate the wheel to highlight the **Stop** button and press the wheel to stop the test.
10. Rotate the wheel to the **Return** button and press the button to exit the test.
11. To verify calibration, repeat the **NBP Accuracy Test** on page 6-8.
12. If you do not get the expected results after several tries, see Chapter 7, *Troubleshooting***.**

Pneumatic Leakage Test

To check the pneumatic system and valve:

1. Select **NBP Test** from the **System Diagnostics** menu.
2. Squeeze the manometer pump to apply a pressure of 250mmHg to the monitor and record this value as **P1**.
3. Let the manometer pressure stabilize for 15 seconds.
4. Watch the pressure value in the **NBP Test** window for 60 seconds, and record this value as **P2**.
5. Calculate and document the leakage test value **X3** (where **X3** = **P1** - **P2**). The leakage test value should be less than or equal to 6mmHg.
6. If the leakage test value exceeds 6mmHg, check the test setup cuff and tubing, then test again. If the test still fails, check the pneumatic tubing inside the monitor.
7. If you cannot eliminate the leak, see Chapter 7, *Troubleshooting***.**

NBP Overpressure Valve Test

To check the overpressure operation of the NBP valves.

1. When performing the static pressure test (see "NBP Accuracy" on page 6-8), squeeze the manometer pump to apply a pressure of 290mmHg to the monitor.
2. Verify that the valves open, releasing pressure on the manometer.

The monitor displays an NBP Overpressure message.

3. If you do not get the expected results, see Chapter 7, *Troubleshooting***.**

Temperature

Before you Start: See "Required Test Equipment" for a list of the equipment that you need to perform this test.

This test uses a fixed temperature value to check the performance of the WelchAllyn SureTemp® Plus temperature module. To test the performance of temperature measurement:

1. Remove any SureTemp probe connected to the monitor.
2. Connect the SureSigns temperature CalKey (part # 4535 640 33691).
3. Wait for the monitor to display the static temperature value.
4. Check that the displayed temperature reads 36.3 +/- 0.1 ^{o}C (97.3 +/- 0.2 ^{o}F)
5. If the value is not within tolerance, see Chapter 7, *Troubleshooting***.**

Safety Tests

Use the following safety test procedures for verifying safe installation or service of the monitor. The setups used for these tests and the acceptable ranges of values are derived from local and international standards but may not be equivalent. These tests are not a substitute for local safety testing where it is required for an installation or a service event. If using the Metron Safety tester, perform the tests in accordance with your local regulations, for example in Europe use IEC60601-1/IEC60601-1-1 and in the US use UL2601-1. The Metron Report should print results with the names listed below, together with other data.

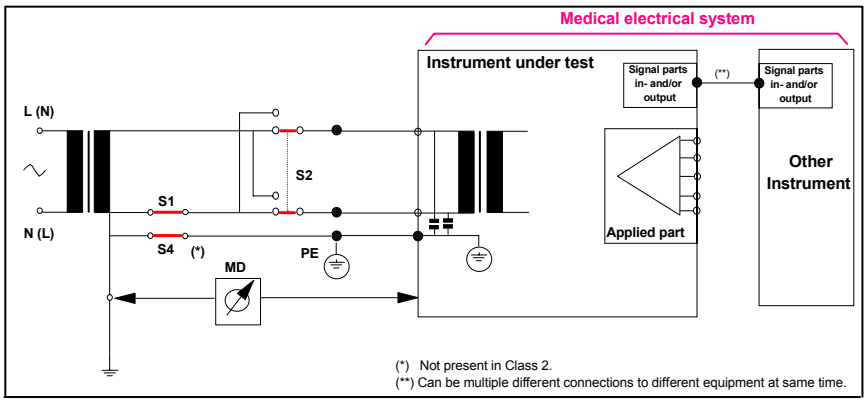
Note Safety tests meet the standards of, and are performed in accordance with IEC 60601-1, Clause 19 (EN60601-1: 1990). The SureSigns VS3 vital signs monitors have been classified as Class IIb equipment. They are double insulated and do not require a protective earth (ground) wire.

The monitor safety tests include:

- System Enclosure Leakage
- Ground integrity
- Patient leakage current with mains voltage

System Enclosure Leakage

S(1) Part 1: System Enclosure Leakage Current - NC (normal condition)



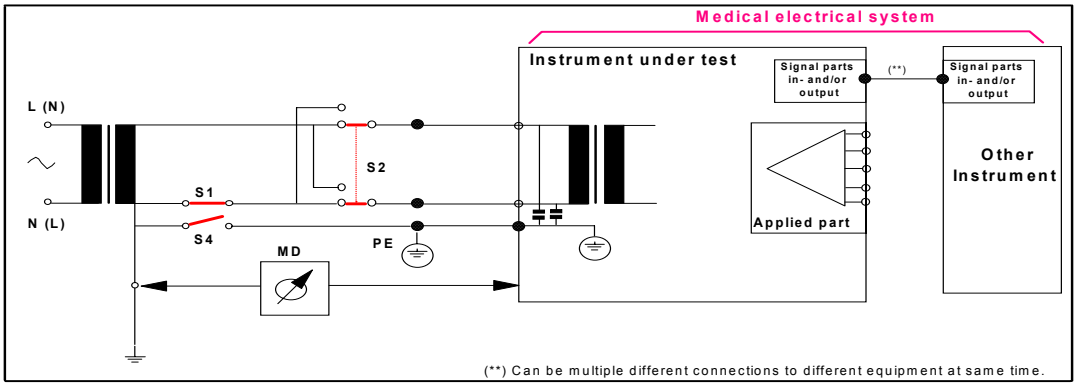
Expected Test Results

Normal condition maximum leakage current x1 ≤ 100µA

This measures leakage current of exposed metal parts of Instrument under Test (IUT) and between parts of the system within the **patient environment**; normal and reversed polarity using S2.

Safety test according IEC 60601-1 / UL2601-1

S(1) Part 2: System Enclosure Leakage current - Single Fault (open earth)



Expected Test Results

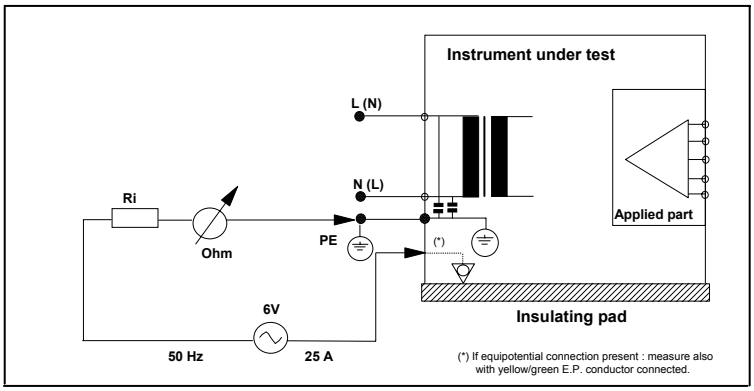
Single Fault maximum leakage current x2 ≤ 500µA (IEC 60601-1)

≤ 300µA (UL2601-1)

This measures leakage current of exposed metal parts of Instrument under Test (IUT) with Protective Earth (PE) open circuit (S4 = open) and between parts of the system within the **patient environment**; normal and reversed polarity using S2.

Ground Integrity

S(2) Protective Earth Continuity



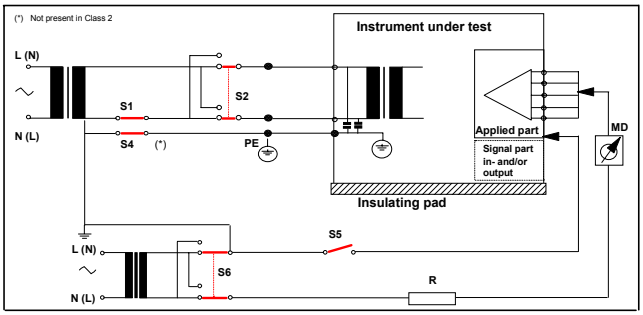
Expected Test Results

With mains cable, maximum impedance x = 100 mOhms (IEC 60601-1 and UL2601-1)

This measures impedance of Protective Earth (PE) terminal to all exposed metal parts of Instrument under Test (IUT), which are for safety reasons connected to the Protective Earth (PE). Test current 25 Amp applied for 5 to 10 seconds.

Patient Leakage Current With Mains Voltage

S(3) Patient Leakage current - Single Fault Condition (S.F.C.) mains on applied part



Expected Test Results

Maximum leakage current, x = 50µA @ 250V (IEC60601-1 and UL2601-1)

Measures patient leakage current from applied Part to earth caused by external main voltage on applied Part with switch S5 open and closed. Each polarity combination possible is tested using S2 and S6. This test is applicable for every measurement input.

Battery Maintenance and Indicators

This section describes how to handle, maintain, dispose of, and check the status of the battery. The information in this section only applies if a battery board is installed in the monitor.

About the Battery

The rechargeable Lithium-Ion battery used in the monitor are *smart batteries* with built-in circuitry that communicates battery status information to the monitor. When the monitor is connected to an AC power supply, the battery begins charging automatically.

To get the longest life out of the batteries, observe these guidelines:

- If a battery shows damage or signs of leakage, replace it immediately.
- ***Never*** use a faulty battery in the monitor.
- Dispose of batteries in an environmentally-responsible manner. Consult the facility administrator or your local Philips representative for local arrangements. ***Never*** dispose of the battery in a normal waste container.
- Batteries should ***never*** remain inside the monitor if they are not used for a long period of time. Batteries should always be charged no more than 50% when stored.

Note—To maximize the life of the monitor's lithium ion battery, Philips recommends that the battery be fully recharged (overnight) at least once per month.

Battery Indicators

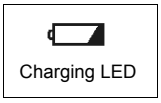
You can check the status of the battery (level of charge) by:

- The battery LED on the monitor
- The battery status pane
- Battery messages and alarms

Battery LED

When you first receive the monitor, the battery charge may be low. You should connect the monitor to an AC power source before using it on battery power alone.

The Charging LED on the front panel provides the charging status of the battery.

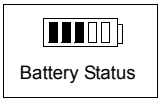


The color of the LED shows how much charge remains on the battery:

LED Color	Charge Level
Green	Full or nearly full
Flashing green	Medium
Yellow	Low
Flashing yellow	Nearly discharged

Battery Status Pane

The battery status pane on the bottom of the LCD screen also indicates battery status.



Battery Messages and Alarms

A technical alarm could indicate a low and/or improperly functioning battery. The following technical alarms indicate a low or problem battery:

Message	Description
Low Batt	Remaining battery power is very low.
Extreme low batt	Battery is nearly discharged.
Temp Module Malfunc	There is a module malfunction. See the error log for details. Error could be caused by the battery or power supply voltage being out of range

In addition, a service error code could indicate a problem with the battery. Service error codes are written to the Error Log. The following are some service errors related to battery function

Code	Description
257	Battery charger power failure
261	Battery is overcharged
264 *temp_value*	Battery is over temperature

For a complete list of error codes and actions to take, see Chapter 7, *Troubleshooting*.

Nurse Call Relay Test

Before you Start: See “Required Test Equipment” on page 6-5, for a list of the equipment that you need to perform this test.

The nurse call relay test checks the nurse call alarm output relay. The nurse call alarm output in the SureSigns VS3 vital signs monitor uses a phone jack connector tip or ring and is capable of both normally closed *and* normally open relay operation. Only perform this test if your site uses the nurse call function of the monitor.

The nurse call connector has three contacts. From the end of the jack, the three contacts are tip, ring, sleeve.

Tip:	Relay normally open; closed for alarm
Ring:	Relay normally closed, open for alarm
Sleeve:	Common

This way if someone were to use a two contact jack they would pick up the normally open contact, which is the more commonly used one.

To perform the nurse call relay test:

1. Plug the phono connector into the Nurse Call connector on the back of the monitor.
2. Use the ohmmeter and simulator to verify relay operation as follows.

Barcode Scanner Test

The barcode scanner test checks the scanner's ability to accurately read data and input that information into the monitor.

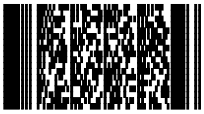
To perform the barcode scanner test:

1. Print the following sample barcodes.

Code 39

Code 128

PDF417



2. Scan the first barcode.
3. The monitor opens the **New Patient Menu**. The information written below the barcode should appear in the Patient ID fields. Press the **Main Screen** button on the front panel to close the menu. If the barcode information does not appear, see Chapter 7, *Troubleshooting*.
4. Repeat steps 2 and 3 for the remaining barcodes.

7
Troubleshooting

In This Chapter

- Introduction 7-2
- Support Strategies 7-2
- Diagnosing a Problem 7-3
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Warning **Do not attempt to troubleshoot the monitor if there is any sign of burning or smoking from the monitor. Call the Philips Response Center or your local Philips representative immediately.**

Introduction

Before you start to troubleshoot the monitor, you should identify important information about the monitor, including the hardware and software version. The **System** menu displays the:

- Serial number
- Hardware Version
- Software Version
- Ethernet MAC address
- Ethernet IP address
- Language
- Device Name
- Configuration

To access the **System Admin** menu, see the section “Accessing the System Admin Menu” on page 5-2.

Note—You can also find the serial number on the back of the monitor.

Support Strategies

There are two methods of repairing the monitor:

- Unit exchange
- Bench repair

Unit Exchange

The primary repair method for the SureSigns VS3 vital signs monitor is unit exchange. The current design of the monitor requires testing if the case is opened.

Bench Repair

Special tools are required to repair the monitor. The section, “Tools required for service” on page 8-2 lists these. If you open the case for a repair, you then must perform specific tests after reassembly. Chapter 6, *Performance Verification Testing* lists these tests in detail and also includes recommended frequency.

The troubleshooting techniques in this chapter show how to troubleshoot a monitor that is not operating correctly. Chapter 8, *Repairing the VS3 Monitor* gives sufficient details for performing assembly level bench repairs.

Before performing a repair, consider whether a replacement would be more suitable. The Philips Parts Center stocks board level assemblies and mechanical parts based on existing failure data and customer demand. Chapter 9, *Replacement Parts and Assembly Diagrams*

lists these parts and assemblies. Service notes announce the availability of additional spare parts.

Diagnosing a Problem

Before you begin to troubleshoot a problem — or open the monitor — ensure that the monitor has power and a functioning display.

Check the basics first. For example:

1. Is the power switch turned on?
2. Is the battery adequately charged?
3. Is the AC power cord connected to the monitor and plugged into an AC outlet?

You can isolate many problems by observing the indicators on the monitor before you open it for repair.

Note—It might take several seconds for the AC Power LED to light/turn off after the main AC power cord has been connected/disconnected.

If the monitor is not receiving power:

1. Check "Boot and Power Sequences" on page 7-4, then follow the troubleshooting steps in section "Power Problems" on page 7-6.
2. If the monitor has no — or an incorrect — display, follow the troubleshooting steps in the section "Display Problems" on page 7-8.

Having power and an active, functioning display is critical to understanding the status of the monitor. Once the monitor has power and a functioning display, you can use the information in this chapter to diagnose other monitor problems.

When You Cannot Correct a Problem

Use the troubleshooting tables, run the diagnostics, refer to the error codes in this chapter, and then take the recommended actions to correct the majority of problems. If you still cannot isolate a problem after using the tables and diagnostics in this chapter, call the Philips Response Center or your local representative.

Boot and Power Sequences

The following describes the regular boot and power on phases of the monitor and its components. If the monitor does not behave as described in the following table, check the Troubleshooting table on page 7-5.

In order for the monitor to boot correctly, it must be powered correctly and the +3.3V system board supply voltage must be working properly. This is indicated by the green LED over the battery icon.

The following table shows the boot and power on sequences.

User Action/Monitor Context	Description
Plug AC or battery (or both) into an unpowered monitor	Screen displays color bar for about five seconds. LCD is off and battery LED lights (when battery available).
Press **Power** button	Philips screen displays and a tone sounds. The **Date/Time** window displays for a new time setting. After the **Date/Time** window is acknowledged, the screen displays.
Press the **Power** button of a monitor (with AC and/or battery) that is off.	Screen displays color bar for about five seconds. LCD is off and battery LED lights (when battery available). Philips screen displays in one second and a tone sounds.
Software reset (system or user)	Screen displays color bar for about five seconds. LCD turns off and battery LED lights (when battery available). Philips screen displays in one second and a tone sounds. The screen displays.
Plug AC into a monitor that is off (battery only).	Screen displays color bar for about five seconds. LCD is off and battery LED lights (when battery available).
Press **Power** button	Philips screen displays and a tone sounds. **New Patient** window displays for new patient settings. After the **New Patient** window is acknowledged, the screen displays.
Press the **Power** Button when monitor is in suspended mode (AC and/or battery).	A tone sounds. **New Patient** window displays for new patient setting. After the **New Patient** window is acknowledged, the screen displays.
Press the **Power** Button when monitor is on (AC and/or battery).	Philips screen displays and LCD turns off.
Press the **Shutdown** button in the **System Admin** menu.	Philips screen displays and a tone sounds. The LCD turns off.

Troubleshooting Charts

Use the following charts to diagnose and fix monitor problems. The charts describe a monitor problem by symptom, list a possible cause, then a suggested action. Check the first possible cause listed, then perform the associated action to repair the problem. Perform all actions in the order that they appear in a chart.

Monitor problems can be related to:

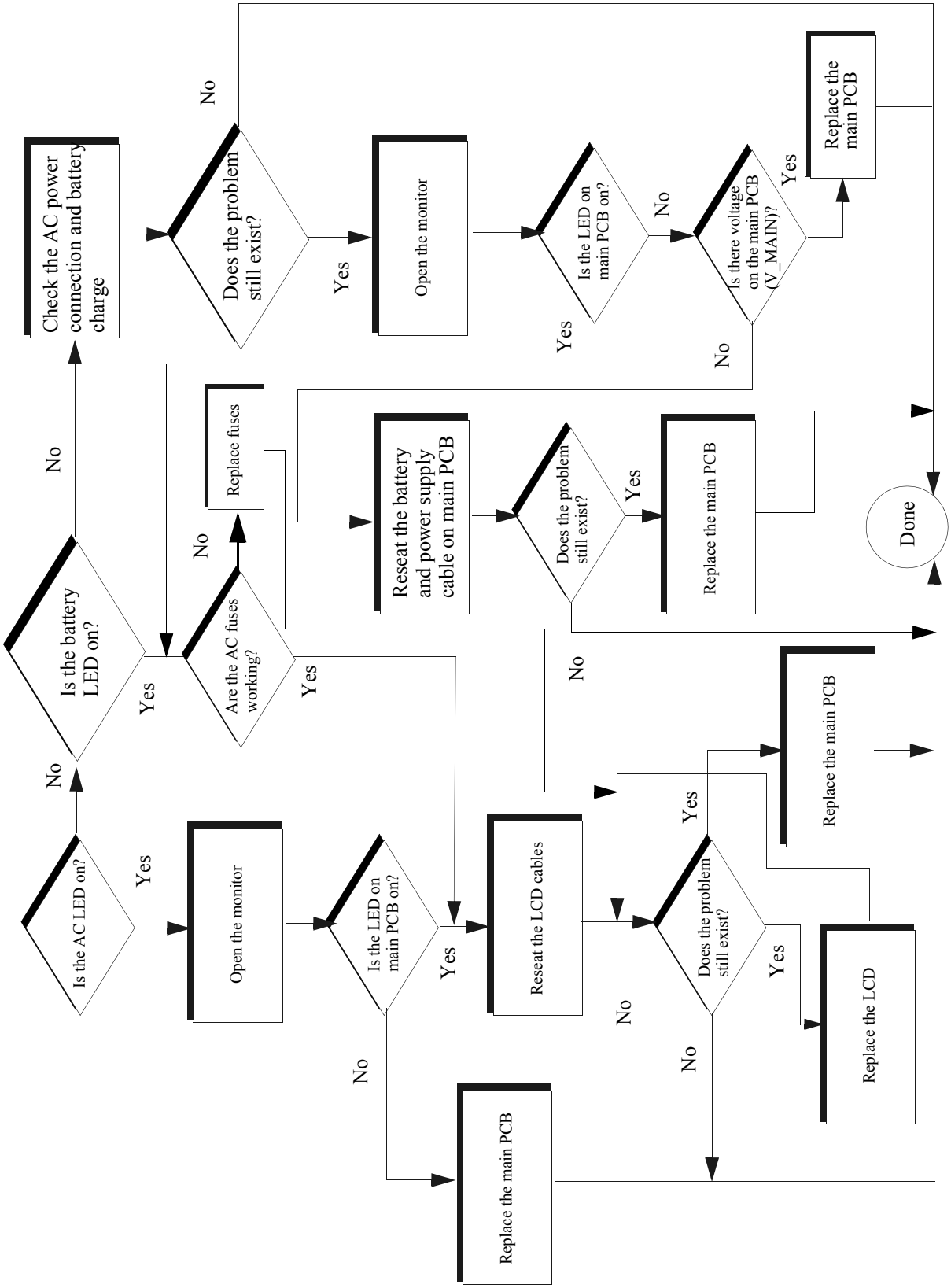
- Power
- Display
- Alarms
- NBP unit
- Measurements, including:
  - Temperature
  - SpO_2
- Recorder
- Barcode Scanner

If using the following troubleshooting charts does not solve the problem, see “Running System Diagnostics” on page 7-23.

Power Problems

Symptom	Possible Cause	Action
I can't turn on the monitor with AC power, but can with battery power.	The cord is unplugged or broken.	Ensure that the AC power cord is plugged into an outlet.
	The fuse is blown.	Replace the fuse. See "Removing a Power Connector Fuse" on page 8-6.
	The power supply cable has malfunctioned.	Replace the DC In cable. See "Removing the Power Supply" on page 8-27.
	The power supply has malfunctioned.	Check output voltage on power supply. If you do not measure 15 V, replace the power supply. See "Removing the Power Supply" on page 8-27.
	The AC power connector has malfunctioned.	Replace the AC connector. See "Removing the AC Power Connector" on page 8-33.
	The monitor keypad is worn.	Replace the front panel. See "Removing the LCD" on page 8-38.
	The main board has malfunctioned.	Replace the main board. See "Removing the Main PCB" on page 8-28.
I can turn on the monitor with AC power, but not battery power.	The battery has lost its charge.	Charge the battery. For more information, see "Charging the Battery" on page 3-3.
	The battery or connector is loose.	Reseat both the battery and battery cable.
	The battery does not have a connection to the main board.	Replace the battery board. See "Removing the Battery Connector Board" on page 8-35.
	The main board has malfunctioned.	Replace the main board. See "Removing the Main PCB" on page 8-28.
I can't get the monitor to turn on with either AC or battery power.	The LCD, cables, battery, power supply, or main PCB has malfunctioned.	Follow the steps in the decision tree in the following power problem diagram.

Power Troubleshooting Flowchart



Display Problems

Symptom	Possible Cause	Action
Power is on, but the monitor screen is blank	The monitor is in power save mode.	Push the **Power** button to end power save mode.
	The speaker and/or fan cables are not connected to the main PCB.	Make sure that the speaker and fan cables are securely connected to the main PCB.
	There is a bad connection with the backlight LCD	Ensure that there is a proper connection between the cable, LCD, backlight and main board.
	There is a bad backlight inverter.	Replace the LCD. See “Removing the LCD” on page 8-38.
	There is a bad LCD.	Replace the backlight board. See “Removing the Backlight Board” on page 8-42
	The main board has malfunctioned.	Replace the main board. See “Removing the Main PCB” on page 8-28.
The monitor displays random/ distorted graphics with a white background.	The LCD cable is not attached correctly.	Open the monitor and reseat the LCD signal cable. See “Front Case Disassembly Procedures” on page 8-38
	The LCD Signal-In cable does not have a ferrite clamp, or the clamp is not properly attached.	Open the monitor and confirm that the ferrite clamp is on the LCD signal cable. See “Front Case Disassembly Procedures” on page 8-38
	The LCD is bad	Replace the LCD. See “Removing the LCD” on page 8-38
	The main board malfunctioned.	Replace the main board See “Removing the Main PCB” on page 8-28.
I turn on the monitor and the opening screen and/or color bar starts, but then just hangs.	The main board is defective.	Replace the main PCB. See “Removing the Main PCB” on page 8-28.
The monitor does not respond to the navigation wheel or front panel buttons	There is a bad connection to the main board.	Ensure that all connectors to the main board are seated correctly.
	The monitor keypad or navigation wheel is broken.	Replace the front panel or navigation wheel. See “Front Case Disassembly Procedures” on page 8-38 and “Removing the Navigation Wheel Assembly Board” on page 8-40.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main PCB” on page 8-28.

Alarm Problems

Symptom	Possible Cause	Action
Audible alarms do not sound	There is a bad connection to the speaker.	Ensure that the connection to speaker is correct.
	The speaker is bad.	Replace the speaker. See “Removing the Fan and/or Speaker Assembly” on page 8-19
	The main board has malfunctioned.	Replace the main board. See “Removing the Main PCB” on page 8-28.
The Auto Set alarm limits button is unavailable.	Auto Set Alarm Limits function is only available when NBP Interval mode is on.	Ensure that the NBP Interval mode is on. Refer to the *SureSigns VS3 Vital Signs Instructions for Use*.

NBP Problems

Symptom	Possible Cause	Action
The NBP cuff does not inflate	The tube or cuff is kinked.	Straighten the tube or cuff.
	There is an air leak in the air tube or cuff.	Replace the cuff and ensure that there is no air leakage in the tube.
	The NBP module has malfunctioned.	Replace the NBP pump module. See “Removing the NBP Module” on page 8-30.
	The NBP pump filter is blocked.	Replace the NBP pump filter. See “Removing the NBP Filter” on page 8-32.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main PCB” on page 8-28.
There are no NBP readings	Wrong cuff size, or incorrect cuff placement.	Use proper cuff size, ensure proper cuff placement.
	There is an incorrect initial pressure setting.	Set a proper initial pressure. See “Changing the Initial NBP Pressure” on page 5-7.
	The tube is kinked or there is air leakage in the air tube or cuff.	Ensure that the tube is straight and not kinked. Replace the cuff and ensure that there is no air leakage in tube.
	There has been some external problem.	Ensure that all external blood pressure reading requirements are met and that the patient is not moving excessively.
	The NBP pump filter is blocked.	Replace the NBP pump filter. See “Removing the NBP Filter” on page 8-32.
	There is an NBP module error.	Replace the pump module or main board. See “Removing the NBP Module” on page 8-30 or “Removing the Main PCB” on page 8-28.

Symptom	Possible Cause	Action
I'm getting unreliable NBP readings	Wrong cuff size, or incorrect cuff placement.	Use proper cuff size, ensure proper cuff placement.
	There is an incorrect initial pressure setting.	Set the initial pressure properly. See "Changing the Initial NBP Pressure" on page 5-7.
	There has been some external problem.	Ensure that all external blood pressure reading requirements are met and that the patient is not moving excessively.
	The calibration is unreliable.	Recalibrate the NBP module see "NBP Calibration Procedure" on page 6-10.

Temperature Measurement Problems

Symptom	Possible Cause	Action
There are no temperature readings	The probe lead is off.	Ensure that the temperature probe is connected.
	The temperature is over range.	Ensure that temperature reading are in the range of 15°-45°C). See "Temperature" on page 6-11.
	The probe has malfunctioned.	Replace the probe.
	There is a front end malfunction.	Replace the front end board. See "Removing the Front End Assembly" on page 8-21.
	The temperature module has malfunctioned.	Replace the temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
	The main board has malfunctioned.	Replace the main board. See "Removing the Main PCB" on page 8-28.
I'm getting unreliable temperature readings	The probe has malfunctioned.	Replace the temperature probe.
	Check temperature module accuracy.	Verify the accuracy of the temperature module. See "Temperature" on page 6-11
	The front end has malfunctioned.	Replace the front end board. See "Removing the Front End Assembly" on page 8-21.
	The temperature module has malfunctioned.	Replace the temperature module. See "Removing the Temperature Module and Holster" on page 8-7.

SpO_2 Measurement Problems

Symptom	Possible Cause	Action
There are no SpO_2 readings	The SpO2 module is in the learning phase.	Wait until the module finishes the learning phase.
	The SpO_2 sensor has malfunctioned.	Replace the SpO_2 sensor. See "Removing the SpO_2 Board" on page 8-25.
	The SpO_2 board has malfunctioned.	Replace the SpO_2 board. See "Removing the SpO_2 Board" on page 8-25.
	The main board has malfunctioned.	Replace the main board. See "Removing the Main PCB" on page 8-28.
The SpO_2 readings are unreliable	There has been some external problem.	Ensure that all external SpO2 reading requirements are met and that the patient is not moving excessively.
	Perfusion is low.	Reset the SpO_2 function. See "Sp02 Tests" on page 6-6

Recorder Problems

Symptom	Possible Cause	Action
The recorder paper is jamming	The paper is not installed correctly.	Remove paper and reinstall correctly.
	The recorder is using improper paper.	Use only the recommend recorder paper.
	The recorder has a mechanical problem.	Replace the recorder module. See “Removing the Faceplate or Recorder” on page 8-13.
The recorder does not print	The paper is out and/or the recorder door is open.	Install a new paper supply. Open the recorder door, then close it again.
	The system does not recognize the recorder.	Check the recorder’s physical connections. See “Removing the Faceplate or Recorder” on page 8-13.
	The recorder module has malfunctioned.	Replace the recorder module. See “Removing the Faceplate or Recorder” on page 8-13.
	The main board has malfunctioned.	Replace the main board. See “Removing the Main PCB” on page 8-28.

Barcode Scanner Problems

Symptom	Possible Cause	Action
The barcode scanner doesn't function. (No laser, no sound; scanner cannot read barcodes)	The scanner is not plugged into the USB port of the monitor.	Check the scanner's physical connection to the monitor's USB port. See page 2-3.
	The system does not recognize the scanner.	Use only the scanner approved by Philips. See "Spare Parts" on page 9-2.
	The scanner has a mechanical problem.	Replace the scanner. See "Spare Parts" on page 9-2.
The barcode scanner cannot read barcodes. (Laser and sounds function, but scanner cannot read barcodes.)	The scanner is held too close or too far from the barcode.	The scanner must be held between 6 and 12 inches from the barcode. See the *Instructions for Use* that accompanied the scanner for further information.
	The system does not recognize the barcode format.	Patient ID/Bed ID barcodes must be written in a recognizeable format. See "Setting up the Optional Barcode Scanner" on page 2-3 for a list of recognized symbologies. If the barcode is written in a recognizable format, and the scanner cannot read the barcode, reset the scanner. See "Resetting the Barcode Scanner" on page 5-17.
	The system does not recognize the scanner.	Use only the scanner approved by Philips. See "Spare Parts" on page 9-2.
	The scanner has a mechanical problem.	Replace the scanner. See "Spare Parts" on page 9-2.

Error Codes

When the monitor detects an error condition (depending on the type of error) an error message appears on the screen or an error code is written to the Error Log.

Error codes can be either:

- Warning
- Service

If an error occurs during monitoring, an audible alarm also sounds. Press the **Alarm Silence** button to end the audible alarm.

Warning Codes

A warning code is typically an indication that an event in the monitor bears attention or intervention and appears in the monitor's message pane.

Warning codes can be physiological or technical alarms. A physiological alarm indicates that the monitor has sensed an unsafe condition, such as Desat or a measurement that has exceeded the alarm settings. A technical alarm indicates that the monitor has sensed a malfunction in the operation of the monitor like an uncalibrated temperature module or NBP air leak.

Service Codes

A service code is an indication that the monitor has detected an error in operation and service might be required. A service code error is a hexadecimal number that indicates the nature of the error.

The following table lists the service error codes that correspond to monitor malfunctions and actions to take when the error occurs. These errors are written to the Error Log. To print an error code log, see "Viewing and Printing Error Logs" on page 7-31.

Code	Description	Possible Cause	Action
257	System Error	Battery charger power failure	Replace the main PCB. See "Removing the Main PCB" on page 8-28. If the problem persists, replace the AC power module. See "Removing the AC Power Connector" on page 8-33.
261	System Error	Battery is overcharged	Run the monitor without AC power. If the problem persists, replace the battery. See "Removing the Battery" on page 8-3. If the problem persists, replace the main PCB. See "Removing the Main PCB" on page 8-28.
264 *temp value*	System Error	Battery over temperature	Shut down and restart the monitor. If the problem persists, replace the battery. See "Removing the Battery" on page 8-3. If the problem persists, replace the main PCB. See "Removing the Main PCB" on page 8-28.
817	FPGA FIFO Overrun	NBP software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See "Removing the Main PCB" on page 8-28.
818 (2)	NBP Equip Malfunc (2)	NBP power-on self test failed because the A/D converter is inoperative, or the pressure transducer offset is too large.	Replace the NBP assembly. See "Removing the NBP Module" on page 8-30. If the problem persists, replace the main PCB. See "Removing the Main PCB" on page 8-28.
818 (15)	NBP Equip Malfunc (15)	NBP abnormal, unrecoverable system errors with internal firmware.	Replace the NBP assembly. See "Removing the NBP Module" on page 8-30. If the problem persists, replace the main PCB. See "Removing the Main PCB" on page 8-28.
818 (25)	NBP Equip Malfunc (25)	NBP hardware has malfunctioned because of no data	Replace the NBP assembly. See "Removing the NBP Module" on page 8-30. If the problem persists, replace the main PCB. See "Removing the Main PCB" on page 8-28.
819	NBP Equip Malfunc - Not Calibrated	NBP not calibrated	Shut down and restart the monitor. If the problem persists, recalibrate the NBP unit. See "NBP Test" on page 6-8.
833 (1)	SpO_2 Equip Malfunc (1)	SpO_2 ROM checksum error	Replace the SpO_2 board. See "Removing the SpO_2 Board" on page 8-25.

Code	Description	Possible Cause	Action
833 (2)	SpO_2 Equip Malfunc (2)	SpO_2 RAM test error	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
833 (4)	SpO_2 Equip Malfunc (4)	SpO_2 analog signal path self test failed	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
833 (6)	SpO_2 Equip Malfunc (6)	SpO_2 self test timeout	Reseat the SpO_2 board. If the problem persists, replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
833 (8)	SpO_2 Equip Malfunc (8)	SpO_2 internal DSP communication error	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
833 (10)	SpO_2 Equip Malfunc (10)	SpO_2 host communication error	Replace the front end assembly. See “Removing the Front End Assembly” on page 8-21. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
833 (20)	SpO_2 Equip Malfunc (20)	SpO_2 hardware defect	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
833 (40)	SpO_2 Equip Malfunc	SpO_2 non-volatile memory corrupted	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
834	SpO_2 Sensor Malfunc	Malfunction of the SpO_2 sensor or sensor cable	Check the SpO_2 cable. If the problem persists, replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25.
835	FPGA FIFO Overrun	SpO_2 software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
836	SpO_2 Communication Error	SpO_2 communication error	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25. If the problem persists, replace the front end assembly. See “Removing the Front End Assembly” on page 8-21. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
837	SpO_2 Error. The front end will now reset itself.	No SpO_2 data	Replace the SpO_2 board. See “Removing the SpO_2 Board” on page 8-25. If the problem persists, replace the front end assembly. See “Removing the Front End Assembly” on page 8-21. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
865	FPGA FIFO Overrun	Temperature software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.

Code	Description	Possible Cause	Action
866 (21)	Temp Probe Error (21)	The probe is operating in temperature conditions above 112°F/43.3°C. Probe tip is defective: heater too close to thermistor.	Replace probe. If the problem persists, replace the SureSigns Temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
866 (22)	Temp Probe Error (22)	Excessive heater energy. Heater not working or it could have taken too long to predict.	Try the temperature measurement again. If the problem persists, replace the probe.
866 (32)	Temp Probe Error (32)	Thermistor pulled away from the tip or heater broken.	Try the temperature measurement again. If the problem persists, replace the probe.
866 (33)	Temp Probe Error (33)	Probe not connected at startup. Probe not responsive. Probe not characterized/ calibrated.	Make sure that the temperature probe is securely connected to the temperature module. If problem persists, replace probe. If problem persists with new probe, replace the SureSigns Temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
866 (34)	Temp Probe Error (34)	Probe not characterized/ calibrated.	Replace probe. If the problem persists, replace the SureSigns Temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
866 (45)	Temp Probe Error (45)	Measurement below allowable temperature values and far below the low ambient and/or patient limits.	Verify conditions at 80°F and 50°F respectively. If conditions are valid and problem persists, replace the temperature probe. If the problem persists, replace the SureSigns Temperature module. See "Temperature" on page 6-11, or "Removing the Temperature Module and Holster" on page 8-7.
866 (46)	Temp Probe Error (46)	Measurement above allowable temperature values and far above the high ambient and/or patient limits.	Verify conditions at 80°F and 50°F respectively. If conditions are valid and problem persists, replace the temperature probe. If the problem persists, replace the SureSigns Temperature module. See "Temperature" on page 6-11, or "Removing the Temperature Module and Holster" on page 8-7.
866 (52)	Temp Probe Error (52)	Probe not characterized/ calibrated.	Replace probe. If the problem persists, replace the SureSigns Temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
866 (63)	Temp Probe Error (63)	Probe well missing or not installed properly	Shut down and restart the monitor. If the problem persists, replace the SureSigns Temperature module. See "Removing the Temperature Module and Holster" on page 8-7.

Code	Description	Possible Cause	Action
866 (70)	Temp Probe Error (70)	Problem reading the probe's EEPROM.	Shut down and restart the monitor. If the problem persists, replace the SureSigns Temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
866 (75)	Temp Probe Error (75)	Problem reading the probe's EEPROM correctly or the probe was not factory tested.	Shut down and restart the monitor. If the problem persists, replace the SureSigns Temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
866 (78)	Temp Module Malfunc (78)	The Probe’s non-volatile error detection mechanism detected an error.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See “Removing the Front End Assembly” on page 8-21 and “Removing the Temperature Module and Holster” on page 8-7.
866 (79)	Temp Module Malfunc (79)	The module’s non-volatile error log memory error detection mechanism detected an error.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See “Removing the Front End Assembly” on page 8-21 and “Removing the Temperature Module and Holster” on page 8-7.
867 (24)	Temp Module Malfunc (24)	Ambient temperature too high.	Check that the fan is running. Check all venting slots of the SureSigns temperature module. Check the thermal shield plate in the module. Verify that the ambient temperature does not exceed operating specifications. If the problem persists, replace the temperature probe. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
867 (25)	Temp Module Malfunc (25)	Ambient temperature too low.	Verify that the ambient temperature does not exceed operating specifications. If the problem persists, replace the temperature probe. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7
867 (27)	Temp Module Malfunc (27)	Battery or power supply voltage exceeds maximum value.	Replace the front end assembly. See “Removing the Front End Assembly” on page 8-21.
867 (28)	Temp Module Malfunc (28)	Battery or power supply voltage below minimum value	Replace the front end assembly. See “Removing the Front End Assembly” on page 8-21.
867 (47)	Temp Module Malfunc (47)	Internal calibration resistor (RCAL) on the board is damaged.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.

Code	Description	Possible Cause	Action
867 (48)	Temp Module Malfunc (48)	Internal calibration resistor (RCAL) is damaged.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
867 (49)	Temp Module Malfunc (49)	Internal circuit validation resistor (PTB) is damaged.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
867 (50)	Temp Module Malfunc (50)	Internal circuit validation resistor (PTB) is damaged.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
867 (51)	Temp Module Malfunc (51)	A/D measurement timed out and did not finish in the allowed time slot.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
867 (59)	Temp Module Malfunc (59)	Battery or power supply voltage below maximum value.	Replace the front end assembly. See “Removing the Front End Assembly” on page 8-21.
867 (60)	Temp Module Malfunc (60)	Battery or power supply voltage exceeds minimum value	Replace the front end assembly. See “Removing the Front End Assembly” on page 8-21.
867 (61)	Temp Module Malfunc (61)	Reference voltage circuit under voltage or unstable.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
867 (62)	Temp Module Malfunc (62)	The module is not calibrated.	Return module to the factory for calibration.
867 (65)	Temp Module Malfunc (65)	Problem saving to the module’s EEPROM.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See “Removing the Front End Assembly” on page 8-21 and “Removing the Temperature Module and Holster” on page 8-7.
867 (66)	Temp Module Malfunc (66)	The module’s non-volatile calibration memory error detection mechanism detected an error.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See “Removing the Front End Assembly” on page 8-21 and “Removing the Temperature Module and Holster” on page 8-7.

Code	Description	Possible Cause	Action
867 (67)	Temp Module Malfunc (67)	Problem reading/writing to the module's EEPROM.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See "Removing the Front End Assembly" on page 8-21 and "Removing the Temperature Module and Holster" on page 8-7.
867 (68)	Temp Module Malfunc (68)	Problem reading/writing to the module's EEPROM.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See "Removing the Front End Assembly" on page 8-21 and "Removing the Temperature Module and Holster" on page 8-7.
867 (69)	Temp Module Malfunc (69)	Problem reading/writing to the module's EEPROM.	Shut down and restart the monitor. If the problem persists, replace the front end assembly and the SureSigns temperature module. See "Removing the Front End Assembly" on page 8-21 and "Removing the Temperature Module and Holster" on page 8-7.
867 (74)	Temp Module Malfunc (74)	Internal error. Module is trying to initialize the EEPROM if it detects that it has not been initialized before.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
867 (80)	Temp Module Malfunc (80)	Software is trying to turn off the probe heater, but the heater feedback signal says it is still on.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
867 (81)	Temp Module Malfunc (81)	Software is trying to turn on the probe heater, but the heater feedback signal says it is still off.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
867 (82)	Temp Module Malfunc (82)	Signal HTR_Q is on and signal HTRC is off, but still have voltage.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
867 (83)	Temp Module Malfunc (83)	Signal HTR_Q is tri-stated with signal HTRC enabled, and has heater power.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See "Removing the Temperature Module and Holster" on page 8-7.
867 (84)	Temp Module Malfunc (84)	Signal Q&C is turned on and the heater voltage is not high enough.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See "Removing the Temperature Module and Holster" on page 8-7.

Code	Description	Possible Cause	Action
867 (85)	Temp Module Malfunc (85)	Heater hardware fail-safe should have turned off, but did not.	Shut down and restart the monitor. If the problem persists, replace the SureSigns temperature module. See “Removing the Temperature Module and Holster” on page 8-7.
868	Temp Error. The front end will now reset itself.	Temperature shows no data	Check the SureSigns temperature module and front end board connection cable. If the problem persists, replace the temperature module. See “Removing the Temperature Module and Holster” on page 8-7. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1025	System Error (1025)	Could not load ResourceDLL.dll.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1026	System Error (1026)	Could not load data from flash.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1027	System Error (1027)	Could not start front-end.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1028	System Error (1028)	Could not stop front-end.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1029	System Error (1029)	Could not allocate enough memory.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1030	System Error (1030)	An error occurred when system shut down front end devices.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1031	System Error (1031)	The monitoring & watchdog thread could not initialize.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1032	System Error	Could not open audio files	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1033	System Error (1033)	Unspecified error.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1034	System Error (1034)	Failed load product info.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1035	System Error (1035)	Cannot Initialize front-end manager.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.

Code	Description	Possible Cause	Action
1036	System Error (1036)	Failed to start work thread.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1037	System Error (1037)	Cannot start polling thread.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1039	System Error (1039)	Cannot get FE Version.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1042	System Error (1042)	Failed to start up network driver.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1043 (1)	System Error (1)	Front end software problem.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1043 (2)	System Error (2)	Alarm software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1044	System Error	Front end software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1045	System Error	Printing software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1047	System Error	Monitoring software problem	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1048	System Error	An exception was detected in the alarming software.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1051	System Error (1051)	Cannot Initialize NBP Device.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.
1050	System Error (1050)	Failed to stop work thread.	Shut down and restart the monitor. If the problem persists, replace the main PCB. See “Removing the Main PCB” on page 8-28.

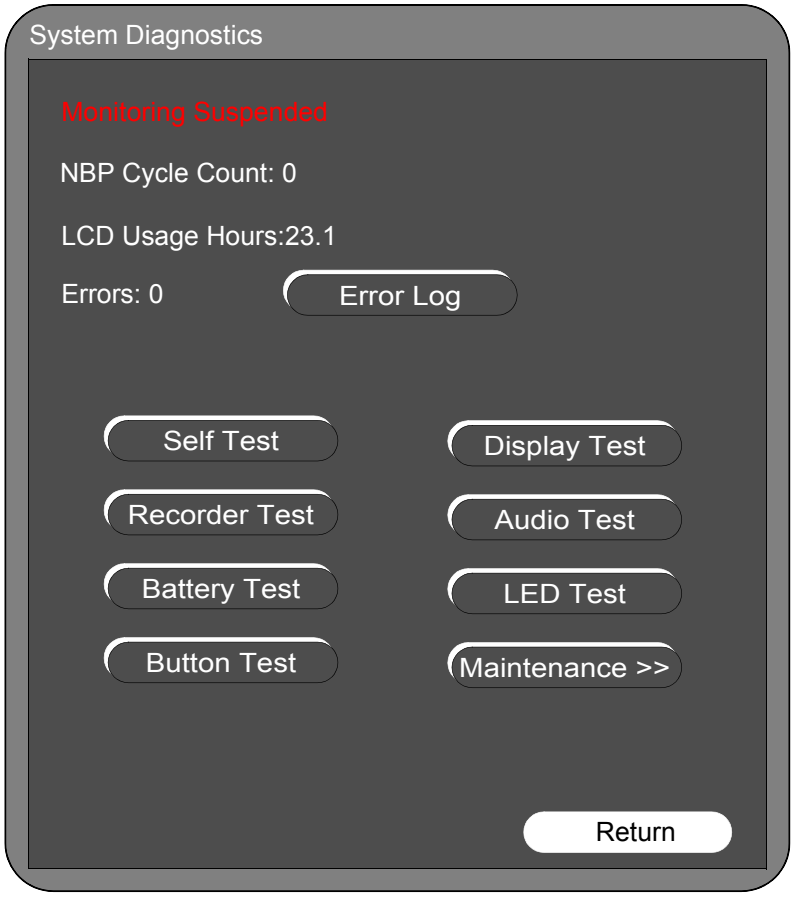
Running System Diagnostics

If the troubleshooting table on page 7-5, or the Error Code table on page 7-14, does not identify the problem, run the system diagnostic software.

To access the system diagnostic software, use the **Diagnostics** button in the **System Admin Menu**. For information on accessing the **System Admin Menu**, see "Accessing the System Admin Menu" on page 5-2.

Note—All patient monitoring is suspended while running system diagnostics.

The following figure shows the **System Diagnostics** window.



Use this window to track usage and perform the monitor's self test. In addition, use the window to perform a variety of system diagnostic and verification tests.

*Note—In order to perform the NBP Test and set several system configuration items, you must enter another password when you click on the **Maintenance >>** button. Only trained biomeds or support persons should access the **Maintenance >>** menu.*

Maintenance Menu

When the **System Diagnostics** menu is open, patient measurements stop. Measurements restart when you exit the **System Diagnostics** menu.

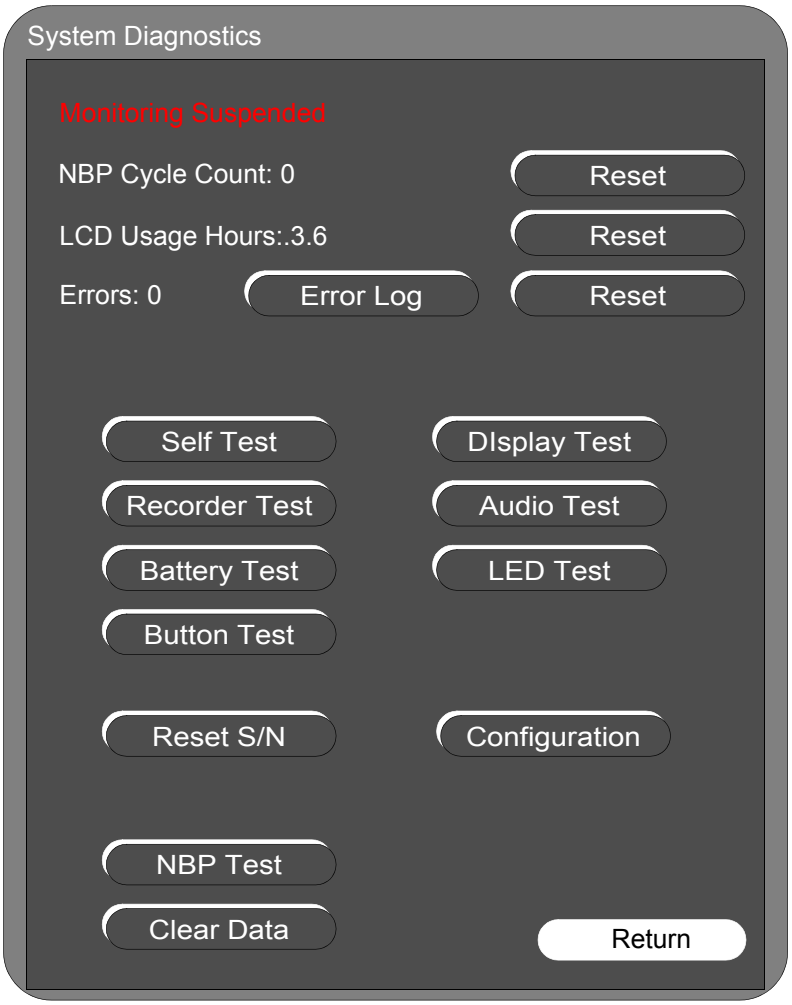
To open the **Maintenance** menu:

1. Rotate the navigation wheel to highlight the ***Maintenance >>*** button in the **System Diagnostics** window and press the wheel.

A **Password** window appears.

2. Enter 1-2-9 in the **Password** window.

The complete **System Diagnostics** menu, including **Maintenance**, appears.



The following sections describe a variety of self- and diagnostic tests that you can run on the monitor, including:

- Self test
- Recorder
- Battery
- Button
- Display
- Audio
- LED

You can also run several verification tests from this menu. For more information on using the **Maintenance >>** menu to run verification tests, see Chapter 6, *Performance Verification Testing*.

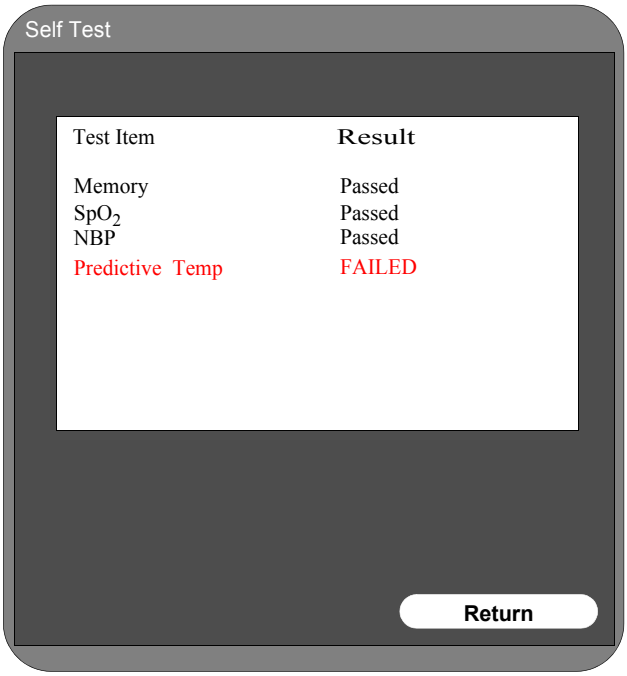
Running the Self Test

The resident self test performs a complete memory and front end test. The monitor could have any of these modules: SpO_2, NBP, Temperature. If the test cannot sense a certain module or an error occurs, then the self-test fails.

To run the monitor resident self test:

1. Press the **Self Test** button.

A window appears displaying the status of the self test. If a test has not completed, the window prints “In Progress”. If a test fails, the window prints “FAILED” in red beside the test.



2. Rotate the wheel to highlight the **Return** button, then press the wheel to return to the main screen when all tests complete.

The **Self Test** window closes. Detected errors are written to the error log with detailed error information and error codes.

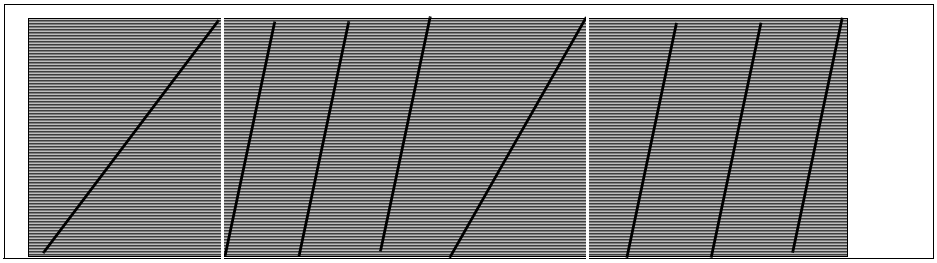
Note—The self test automatically runs each time that the monitor is powered on (cold or warm start), unless it has already run that day.

Testing the Recorder

To test the recorder:

1. In the **System Diagnostics** menu, rotate the wheel to highlight the **Recorder Test** button, then press the button to start the test.

The recorder prints a test pattern similar to this:



2. Use the pattern to identify the recorder problem; for example, a faulty print head or motor.

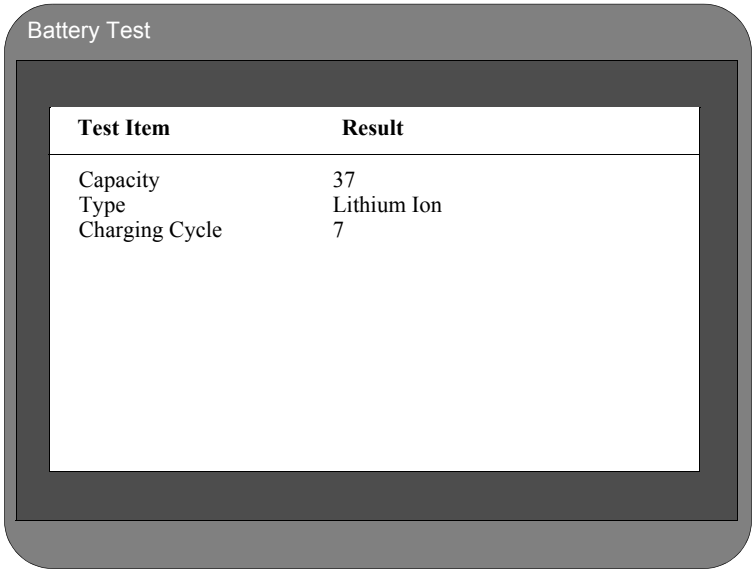
Testing the Battery

The battery test communicates with the battery to sense things like battery capacity and type and charging cycle.

To test the battery:

1. In the **System Diagnostics** menu, rotate the wheel to the **Battery Test** button, then press the wheel to start the test.

A window appears for five seconds, showing the results of the test. For example:



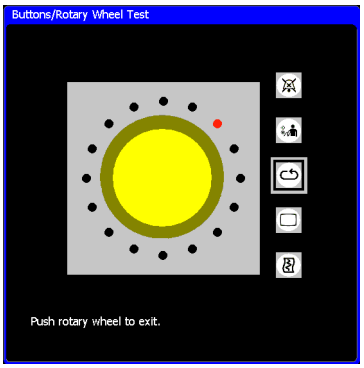
2. To stop the test before the window closes, press the wheel.

Running the Button Test

The Button Test tests the functions of the navigation (rotary) wheel and system buttons. To run the button test:

1. In the **System Diagnostics** menu, rotate the wheel to highlight **Button Test**, then press the wheel.

The **Buttons/Rotary Wheel Test** window appears with several of the system icon buttons in the right side of the window.



2. To test a system icon button, press a button on the monitor.

If the button you press on the monitor is working properly, the corresponding icon in the test window lights with a grey border for five seconds.

3. To test the monitor's rotary wheel, turn the monitor wheel clockwise or counterclockwise.

If the rotary wheel on the monitor is working properly, then the wheel icon draws red dots in the direction that you turn the wheel.

4. To test each small movement of the monitor's rotary wheel, move the wheel by small increments.

If the rotary wheel on the monitor is working properly, then the wheel icon displays a red dot for each small movement of the monitor wheel.

5. To end the test, press the monitor rotary wheel.

Testing the Display

To test the display:

1. In the **System Diagnostics** window, rotate the wheel to highlight the **Display Test** button, then press the wheel to start the test.

The display test draws a sequence of patterns on the monitor screen. Each pattern displays for five seconds. When the last pattern is drawn, the sequence starts again from the first pattern. The following describes the test patterns that are displayed.

Pattern	Description of Screen
Horizontal Bars	Alternating black and white horizontal bars, starting with white. This description is printed on top in red.
Horizontal Bars (inverse)	Alternating black and white horizontal bars, starting with black. This description is printed on top in red.
Solid White	Painted white. The text “White” is drawn in black. The text moves across the screen.
Solid Red	Painted red. The text “Red” is drawn in black. The text moves across the screen.
Solid Green	Painted green. The text “Green” is drawn in black. The text moves across the screen.
Solid Blue	Painted blue. The text “Blue” is drawn in black. The text moves around the screen.

2. To exit the test, press or turn the wheel.

Running the Audio Test

The audio test plays a sample sound on each of the different Db levels. To perform the audio test:

1. In the **System Diagnostics** menu, rotate the wheel to highlight the **Audio Test** button, then press the wheel to start the test.

A window appears confirming that the monitor is entering the audio test and displays the text “Listen for a short tone.” The monitor sounds three short tones at different Db levels. When the test completes, the window closes.

Tracking Component Usage

The monitor tracks the usage of some of its parameters. This can be helpful in diagnosing problems with the monitor. The monitor tracks the following parameters:

Parameter	Description
NBP cycle count	Number of times an NBP measurement has been taken
LCD usage hours	The hours that the system has been on (something displayed on the monitor screen).
Errors	The number of errors that the system has recorded.

Resetting Parameters

Important—You should always reset a tracked parameter after replacing the associated part.

To reset a tracked parameter:

1. In the **System Diagnostics** menu, rotate the wheel to highlight the **Reset** button to the right of the parameter you want to reset, NBP Cycle Count, for example, then press the wheel.

A confirmation window appears before the parameter is cleared.

2. In the confirmation window, turn the wheel to highlight **Yes**, and press it to reset the parameter to 0.

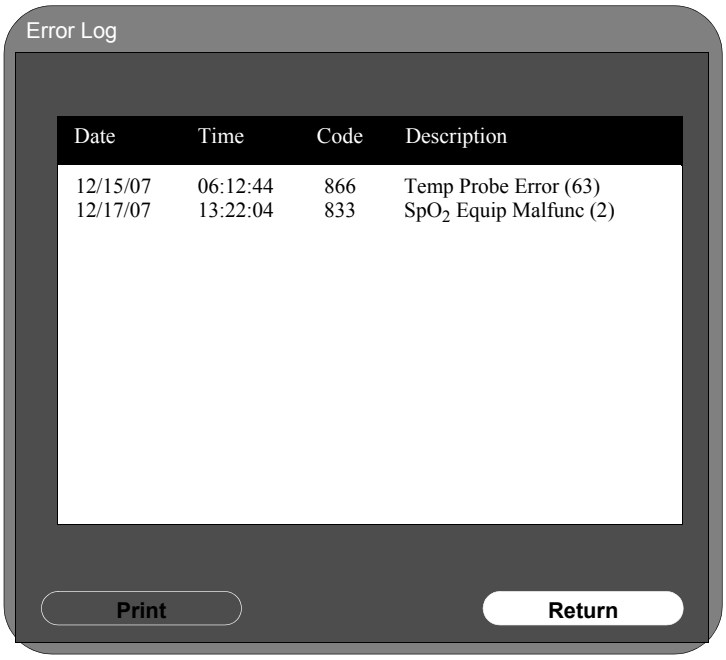
Viewing and Printing Error Logs

The monitor flashes when it has detected an error code, including errors that occur during the self test. In addition, when the monitor detects a system error, it writes that error to a log. The log includes a timestamp for when the error occurred. For detailed information on errors and error codes, see “Error Codes” on page 7-14.

To view the error log:

1. In the **System Diagnostics** menu, rotate the wheel to highlight the **Error Log** button, then press the wheel to view the error log.

The **Error Log** window displays, showing the error log entry, timestamp, unique error code, description of the error, and an optional block of error information.



Note—The error description text always displays in English regardless of current localization settings.

2. To view the errors, use the window scroll bar (if all errors do not fit in the window). You can also use the wheel on the monitor to scroll through the window.
3. To clear the error count and log, see the section, "Resetting Parameters" on page 7-31.
4. To print the error log to the recorder, in the **Error Log** window, rotate the wheel to the **Print** button, then press the wheel.

Testing the LED

To test the monitor LED:

1. In the **System Diagnostics** menu, turn the wheel to highlight the **LED Test** button, then press the wheel to select the test.

A window appears describing the expected LED behavior during the test. If the battery LED is working properly, it:

- Lights in yellow for five seconds
- Lights in green for five seconds
- Flashes in yellow for five seconds
- Flashes in green for five seconds

The power LED remains green during the test.

8
Repairing the VS3 Monitor

Warning **After any monitor repair, you must perform the recommended Performance and Safety tests before putting the monitor into operation. Failure to perform these tests might result in erroneous monitor readings. For more information on performing safety and performance tests, see Chapter 6, *Performance Verification Testing*.**

In This Chapter

- Tools required for service 8-2
- Disassembling the Monitor for Repairs 8-9
- Repairing the Monitor Without Disassembly 8-3
- Disassembling the Monitor for Repairs 8-9
- Rear Case Disassembly Procedures 8-19
- Main PCB Assembly/Disassembly Procedures 8-21
- Front Case Disassembly Procedures 8-38

Tools required for service

The following lists the tools and additional test equipment required to disassemble, repair, and re-assemble the monitor.

- #1, #2 Phillips head screwdrivers
- Torx T10, T20 screwdrivers
- small and medium slotted screwdrivers
- needle nose pliers
- plastic cable zip ties
- wire-cutters
- ESD mat and wrist strap

Monitor Disassembly

The monitor has three main assemblies: the front case, rear case, and main PCB assembly. The monitor can be further disassembled down to all major component parts, including:

- Printed Circuit Boards (PCBs)
- Battery
- Cables
- LCD

Warning	**Before attempting to open or disassemble the monitor, disconnect the power supply from the monitor and remove the battery. High voltage is generated by the LCD backlight driver.**

Caution	**Observe ESD (electrostatic discharge) precautions when working inside the unit.**

Repairing the Monitor Without Disassembly

This section describes the items that you can remove without disassembling the main case of the monitor. You can replace these items without disassembly:

Part	Part Number
Battery (page 8-3)	989 803 144631
Power connector fuses (250V, TIA)	4535 640 31481 – small parts kit
USB clamp	4535 640 31481 – small parts kit
VS3 Temperature module (page 8-7)	4535 640 24651
Recorder assembly (page 8-13)	4535 640 20521

See Chapter 9, *Replacement Parts and Assembly Diagrams* for a complete list (including part numbers) of spare parts.

Removing the Battery

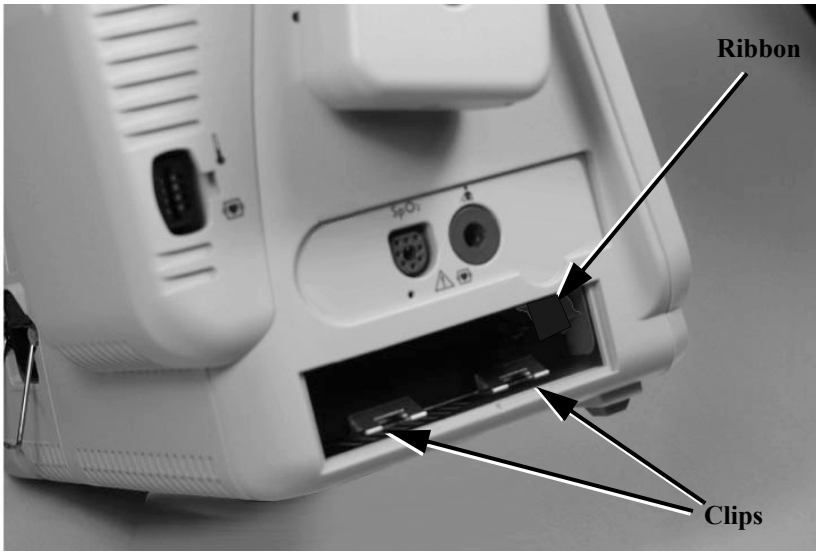
Caution **Before removing the battery, perform a monitor shutdown. For information on performing a monitor shutdown, see "Performing a Hard Shutdown" on page 5-17.**

Note—Never try to remove the battery case cover by inserting the screwdriver into the slots on the cover. This can damage the battery case cover.

To remove the battery:

1. Remove the AC cord from the rear of the monitor.
2. Tip the monitor and insert a slotted screwdriver into the opening just under the battery cover.

3. Slightly twist the screwdriver to pop the battery cover off of the case.
4. Press down on the metal battery retaining clips, and pull the battery out of the monitor by the short black ribbon.



Installing the Battery

To install the battery:

1. Orient the battery so that the contacts and ribbon are on the right.
2. Insert the battery into the empty battery compartment and push it in until the battery snaps into place behind the metal retaining clips.

3. Replace the battery cover by inserting it into the battery case opening with the two small case cover clips up.

4. Snap the battery cover into place by pressing it firmly against the monitor case.

Removing a Power Connector Fuse

To remove a fuse in the AC power connector:

1. Remove the AC cord from the rear of the monitor.
2. Remove the battery from the monitor (see “Removing the Battery” on page 8-3).
3. Use needle nose pliers to lift the fuse holder away from AC power connector.

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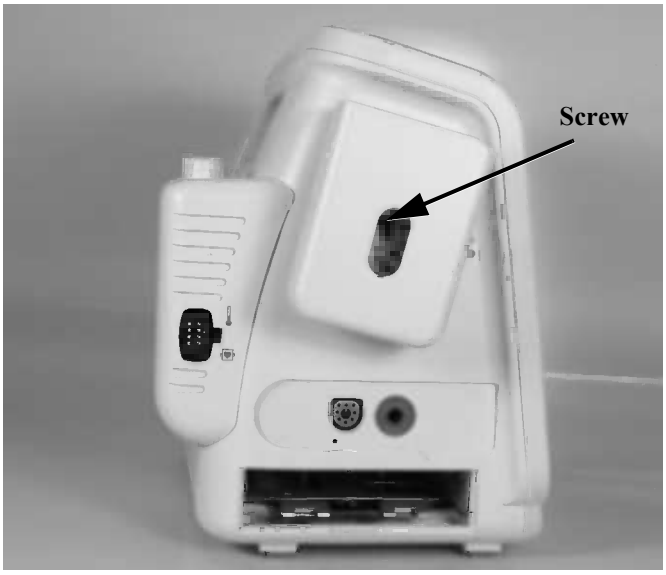
4. Replace the fuse(s), then push the fuse holder back into the power connector until it snaps into place.

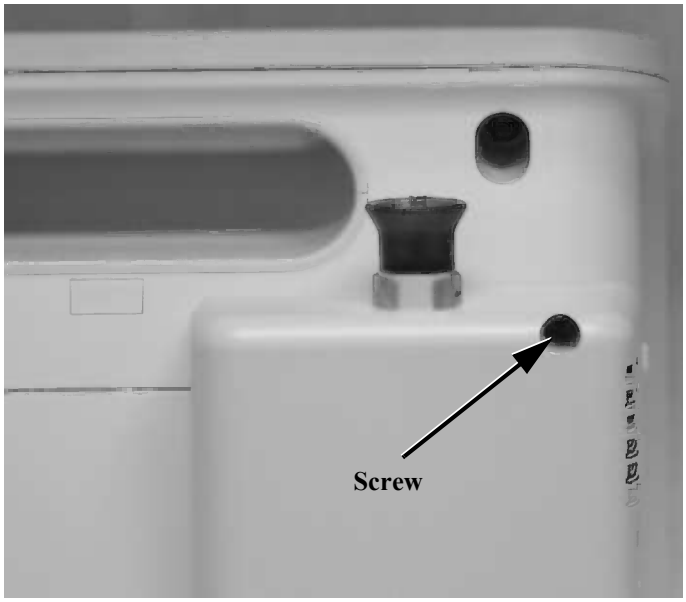
Removing the Temperature Module and Holster

To remove the temperature module and holster:

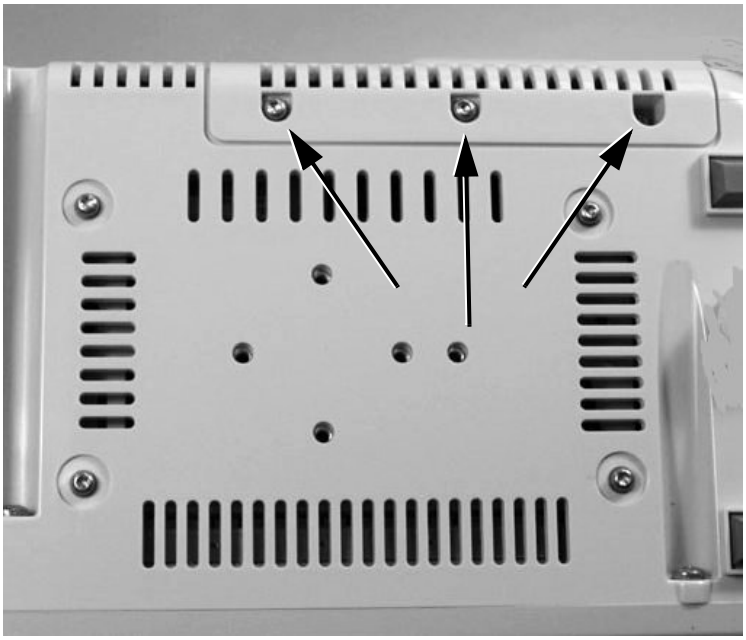
1. Remove the AC cord from the rear of the monitor.
2. Remove the battery from the monitor (see “Removing the Battery” on page 8-3).
3. Remove one Torx T10 screw from the holster.



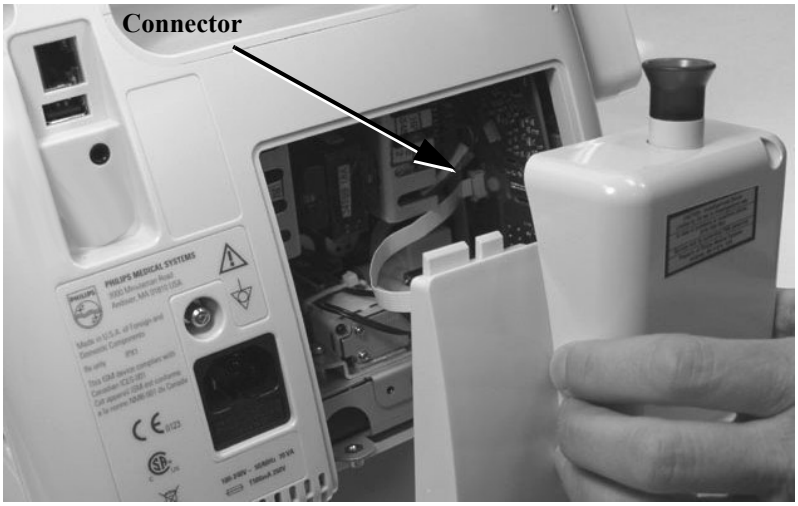
4. Remove one Torx T10 screw from the temperature module.



5. Remove three Torx T10 screws and washers from the bottom of the rear cover.



6. Pull the module away from the rear of the monitor case and disconnect the temperature connector attached to the front end PCB.



Disassembling the Monitor for Repairs

This section describes how to disassemble the monitor in order to replace internal parts.

Separating the Front and Rear Case Assemblies

In order to open the monitor to install internal replacement parts, you must first separate the front and rear case assemblies.

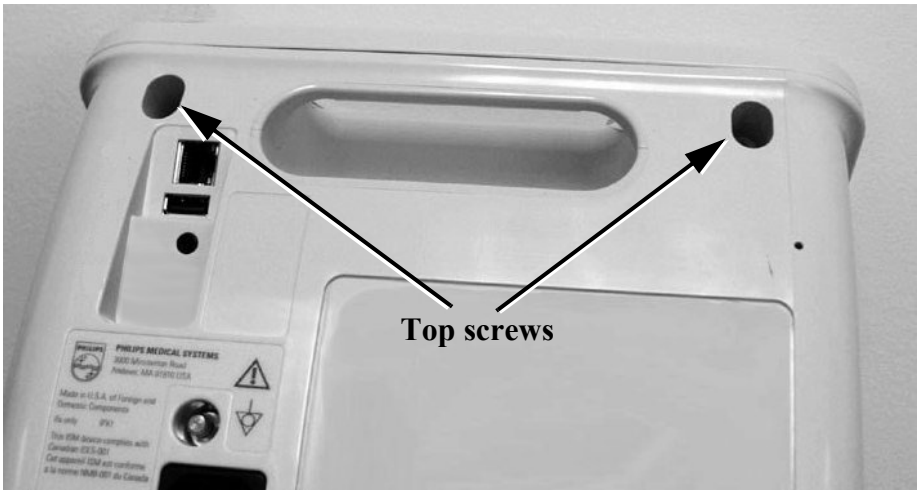
To separate the front and rear case assemblies:

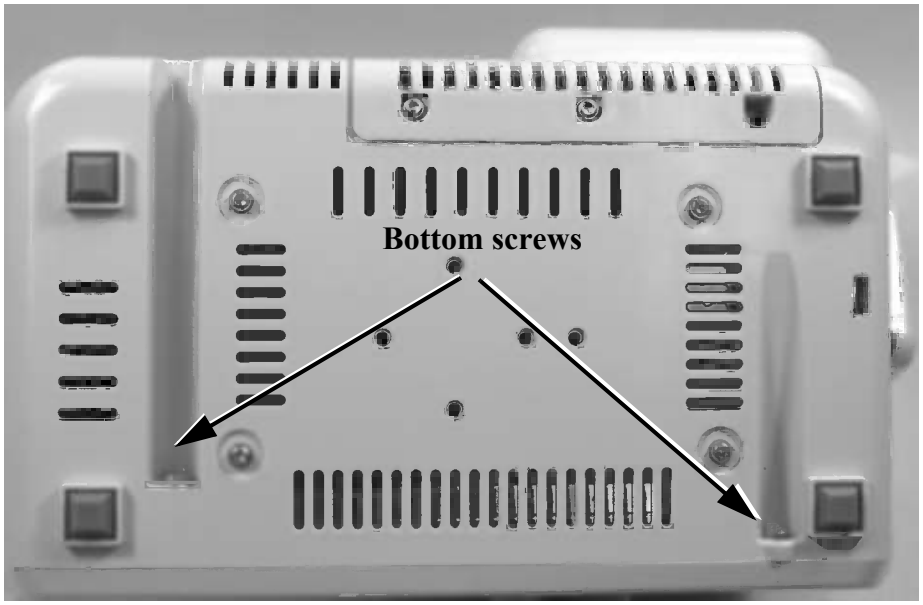
1. Disconnect the AC power cable from the back of the monitor.
2. Remove the battery from the monitor (see "Removing the Battery" on page 8-3).
3. Remove any lines from the patient monitoring and communication connectors.

Warning **The metal edges on the inside of the front case assembly are sharp. Use extreme caution when handling the separated monitor assemblies.**

4. Remove the temperature module from the monitor (see "Disassembling the Monitor for Repairs" on page 8-9).

5. Tip the monitor and remove the four Torx T20 screws (two top, two bottom) holding together the front and rear case assemblies.



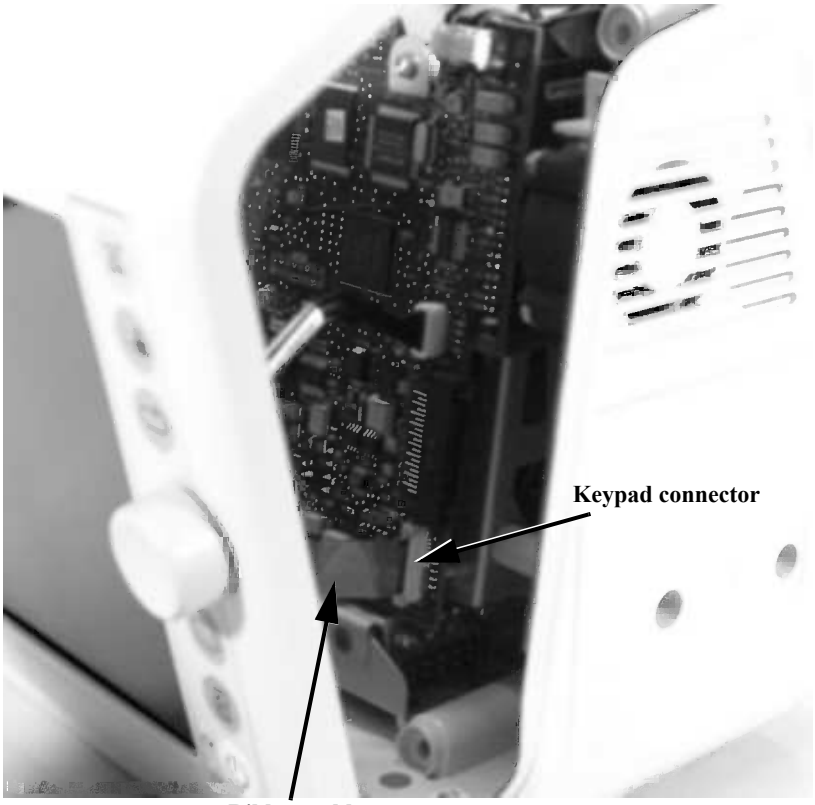


6. Separate the main front and rear case assemblies by pulling the lower edge of the front case assembly and carefully and slowly lifting it up over the handle

Caution **Connectors run between the front and rear case assemblies**

.

7. Disconnect the keypad ribbon cable from the PCB by pulling the keypad connector to release it, then gently pulling the ribbon cable out of the connector.



8. Disconnect the other three cables from the main PCB board.

When Assembling the Front and Rear Cases

1. Connect all cables.
2. To reattach the front and rear cases, line up the tab on the front assembly case with the handle on the rear case and slip the front assembly case over the handle. Snap the two assembly cases together, and install the final four screws.
3. Reinstall the temperature module, beginning with the connector to the front end board (see “Disassembling the Monitor for Repairs” on page 8-9).
4. Power up the monitor. If the monitor boots properly, perform the required performance tests (see “Testing and Inspection Guidelines” on page 6-2).

Removing the Main PCB Assembly

This section describes how to remove the main PCB assembly from the rear case.

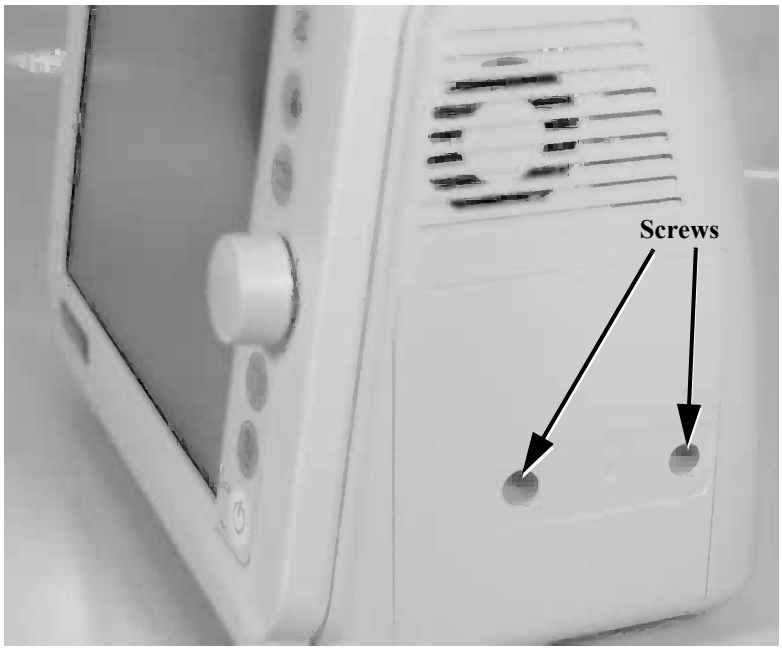
Removing the Main PCB Assembly from the Rear Case

To remove the main PCB assembly:

1. Separate the front and rear case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9.
2. Remove the faceplate or recorder.

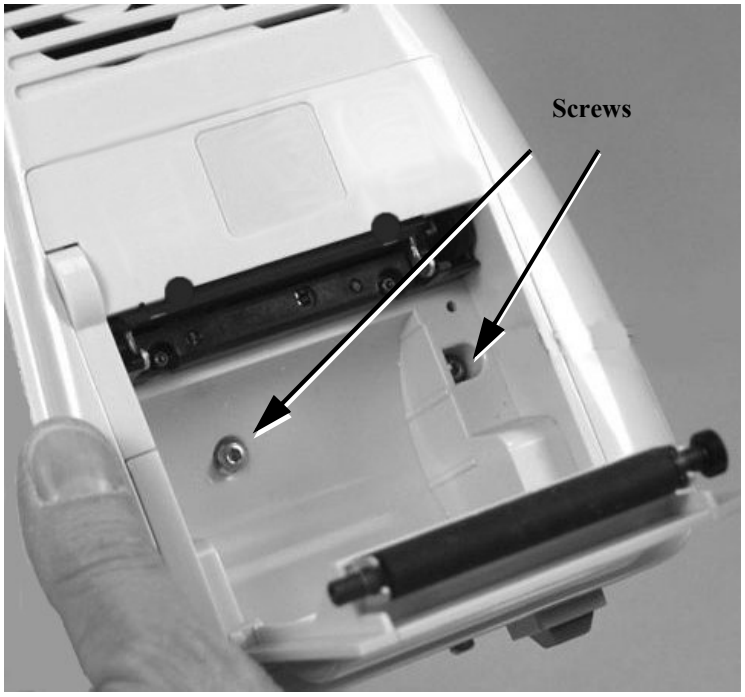
Removing the Faceplate or Recorder

1. For monitors without the recorder, remove the plastic label covering the two Torx T10 screws holding the faceplate to the monitor case.
2. Remove the two screws, and lift the faceplate off.

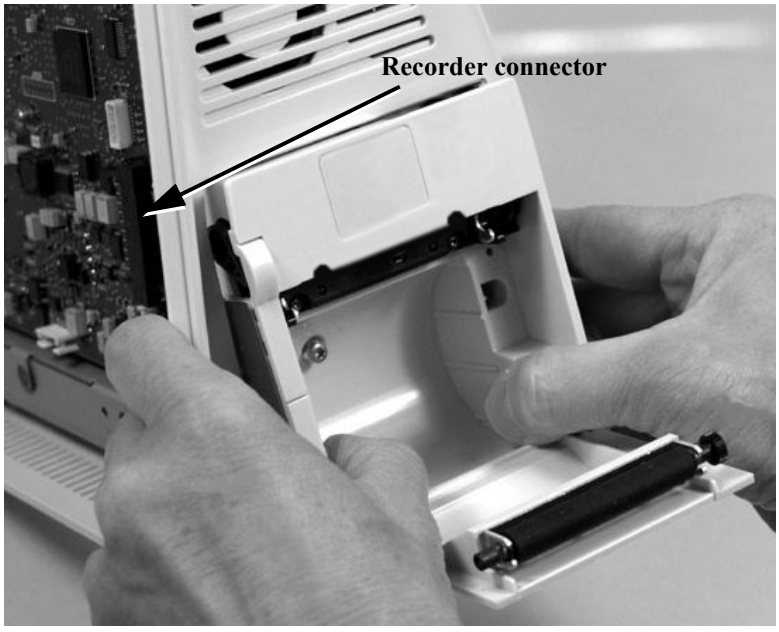


3. For monitors with the recorder, open the recorder door on the rear case assembly and remove the paper roll.

4. Loosen (do not try to remove) the two Torx T10 screws holding the recorder to the monitor case.

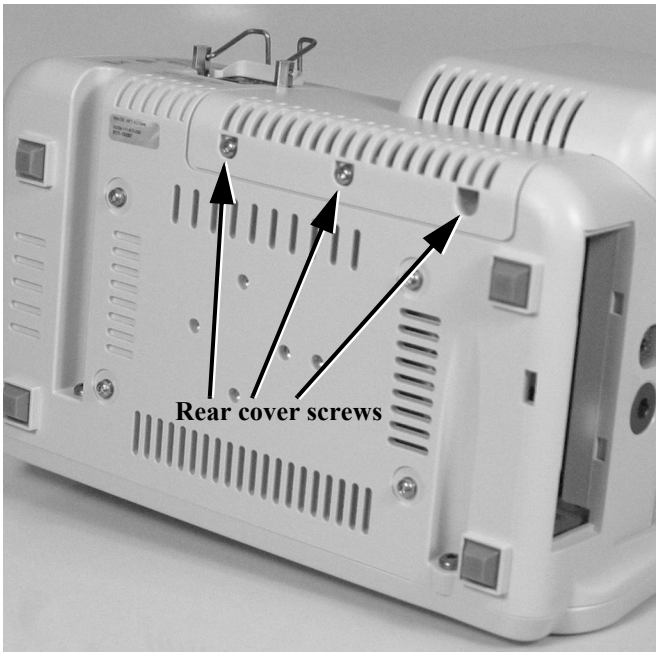


5. Place your two thumbs on either side of the recorder case and pull it straight out of the assembly and away from the recorder connector on the main PCB.

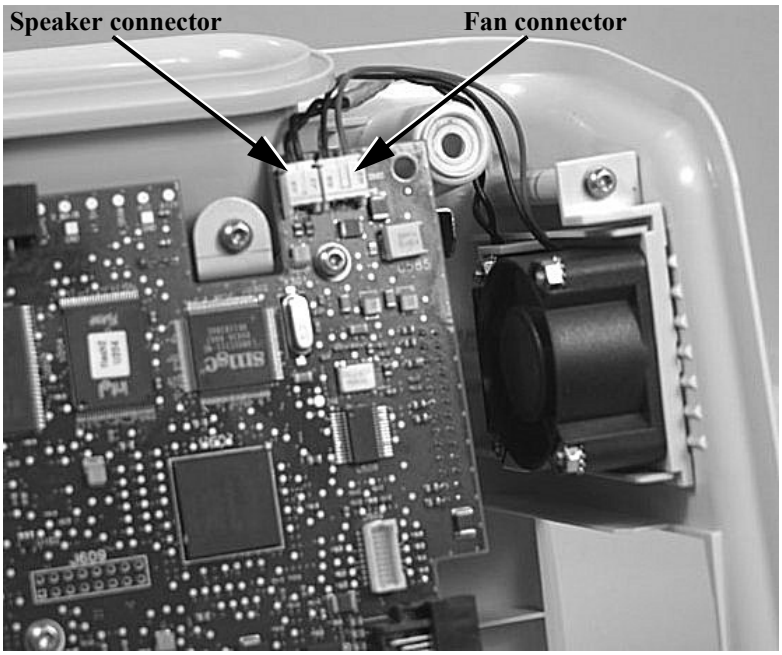


Caution **When reassembling the recorder or faceplate, do not overtighten the screws.**

6. Turn the monitor over and remove the three Torx T10 screws and washers from the rear cover. Remove the module cover from the rear of the monitor.

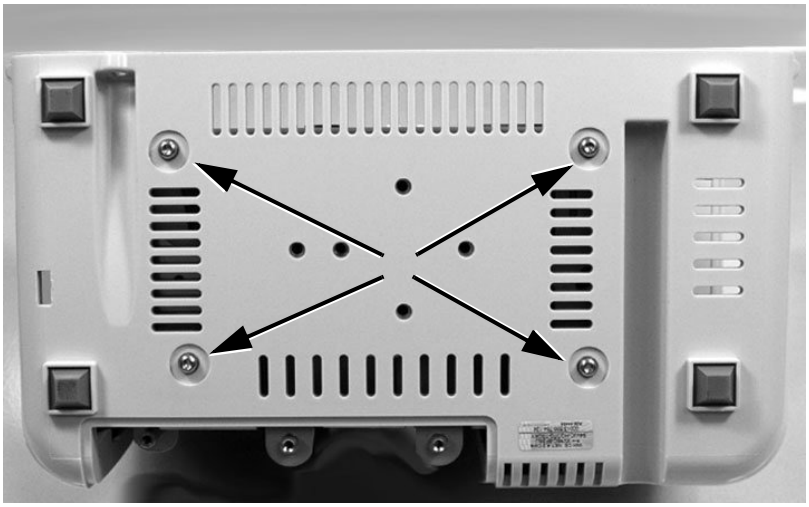


7. Disconnect the fan and speaker connectors from the main PCB.

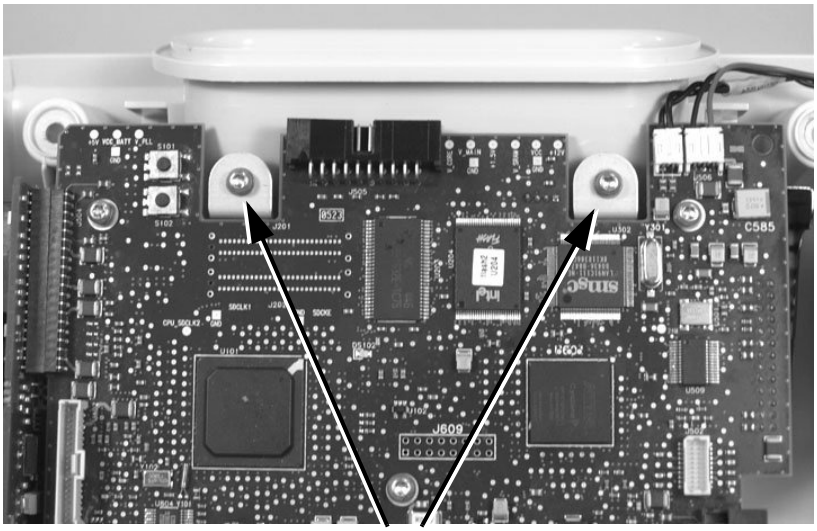


- Speaker = black/black
- Fan = red/black

8. Remove the four Torx T10 screws and washers on the bottom of the rear case assembly.



9. Remove the two Torx T10 screws and washers holding the main PCB assembly in place in the rear case assembly.

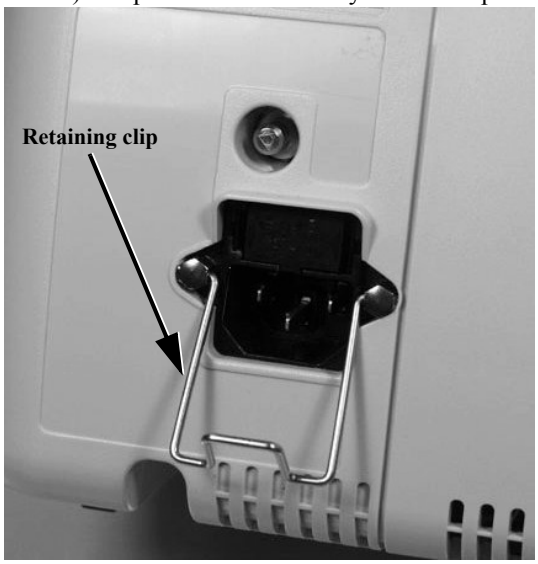


Main PCB screws

10. Slide the main PCB assembly out of the rear case.

When Assembling the PCB Assembly

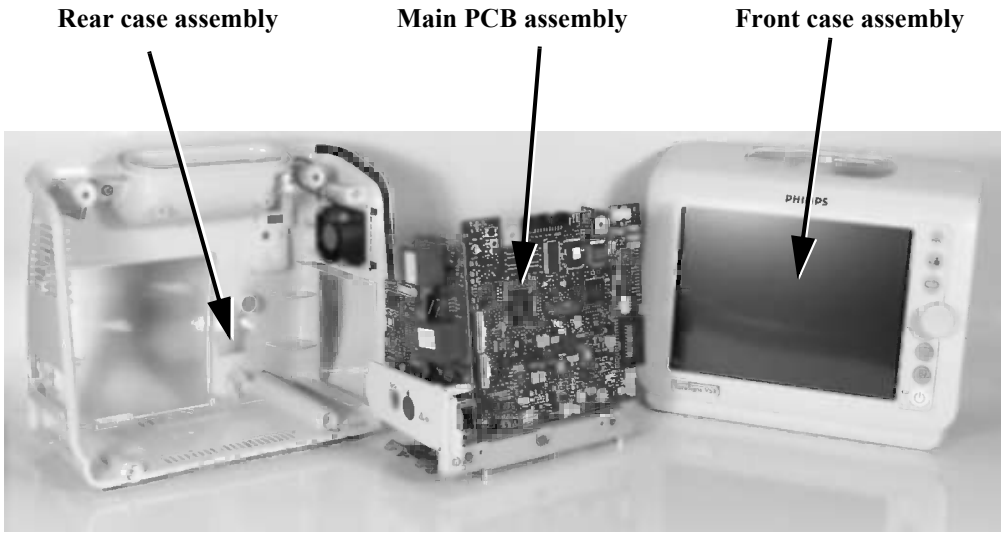
1. Slide the PCB assembly into the rear case (guiding the power cord retaining clip through the rear cover) and push on the assembly until it snaps into place in the case.



2. Replace the four Torx T10 screws and washers on the bottom of the rear case to ensure that the main PCB assembly sits correctly in the case.

There are now three separate items:

- Rear case assembly
- Main PCB assembly
- Front case assembly



Rear Case Disassembly Procedures

This section describes how to remove items in the rear case assembly. You can replace these parts:

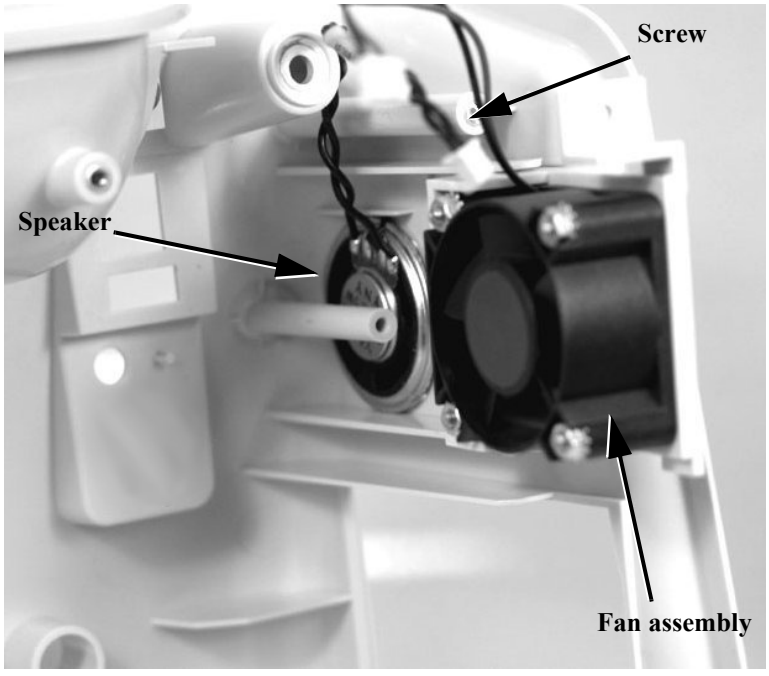
Part	Part Number
VS3 speaker	4535 640 24681
VS3 fan assembly	4535 640 24591
Handle	4535 640 20421

See Chapter 9, *Replacement Parts and Assembly Diagrams* for a complete list (including part numbers) of spare parts.

Removing the Fan and/or Speaker Assembly

To remove the fan and/or speaker assembly:

1. Separate the front and rear case assemblies. See "Separating the Front and Rear Case Assemblies" on page 8-9.
2. Remove the main PCB assembly. See "Removing the Main PCB Assembly" on page 8-13.
3. Remove the one Torx T10 screw and washer holding the fan assembly and slide it out of the rear case.



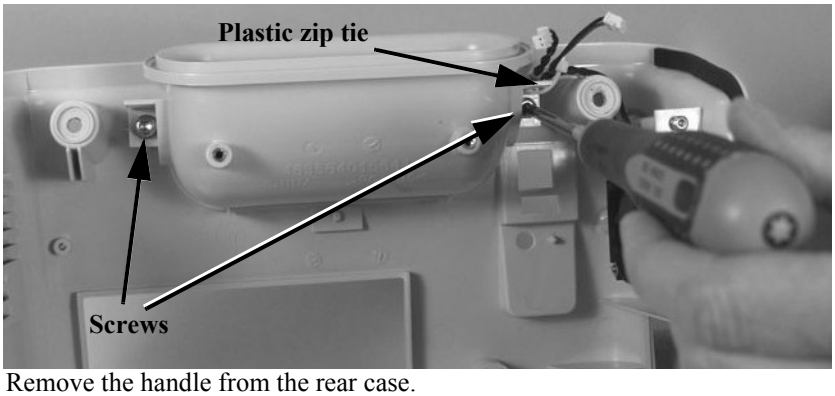
4. Use wire-cutters to cut the plastic zip tie securing the speaker and fan wires to the handle.

Note—When reassembling the fan and speaker assemblies, the cables should be secured to the handle with a new plastic zip tie.

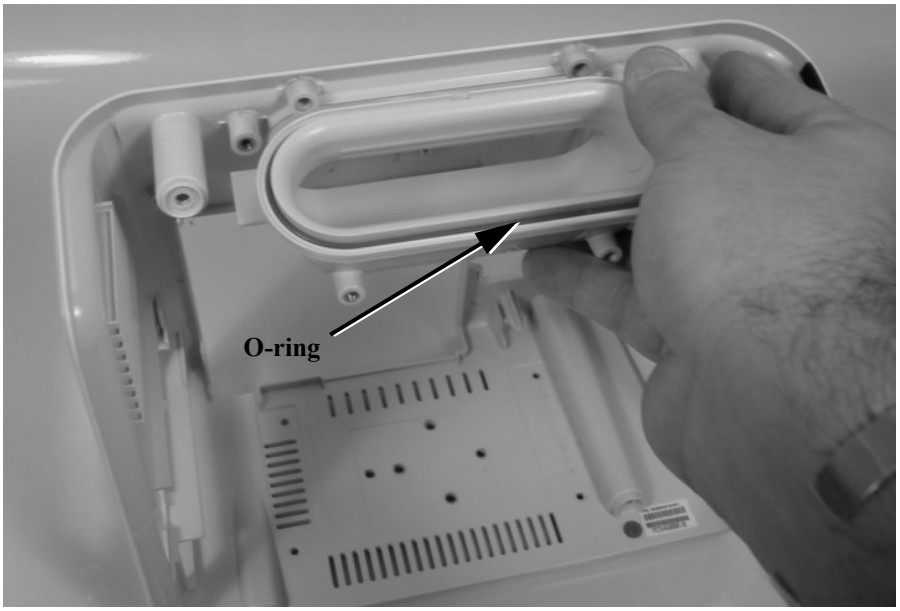
Removing the Handle

To remove the handle:

1. Separate the front and rear case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9.
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.
3. Cut the plastic zip tie securing the speaker and fan wires to the handle and remove the two Torx T20 screws and washers.



4. Remove the handle from the rear case.



Caution **When replacing the handle, check the condition of the O-ring that seals the monitor from moisture. If it is cut or damaged, replace it with a new one from the small parts kit. See Chapter 9, *Replacement Parts and Assembly Diagrams*.**

Main PCB Assembly/Disassembly Procedures

This section describes how to remove items in the main PCB assembly. You can replace these parts:

Part	Part Number
VS3 front end assembly (NBP only)	4535 640 41431
VS3 front end assembly (NBP and SpO_2)	4535 640 41451
SpO_2 board	4535 640 20531
Power supply module	4535 640 20471
Main PCB	4535 640 41381
NBP module with filter	4535 640 20461
NBP filter replacement	4535 640 41171
AC power input connector	4535 640 51201
LAN (I/O Communications) board	4535 640 41481
Battery connector board	4535 640 20271
DC In cable	4535 640 20291

See Chapter 9, *Replacement Parts and Assembly Diagrams* for a complete list (including part numbers) of spare parts.

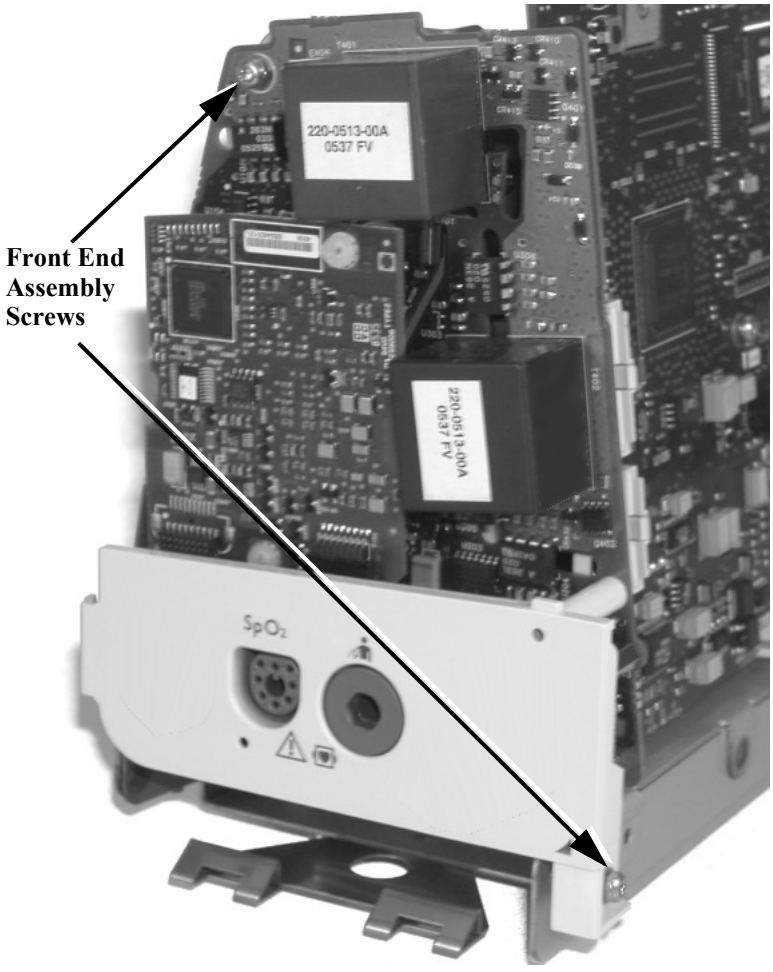
Removing the Front End Assembly

In order to remove the plastic patient connector panel from the front end assembly or SpO_2 board, you must remove the front end assembly from the main PCB assembly.

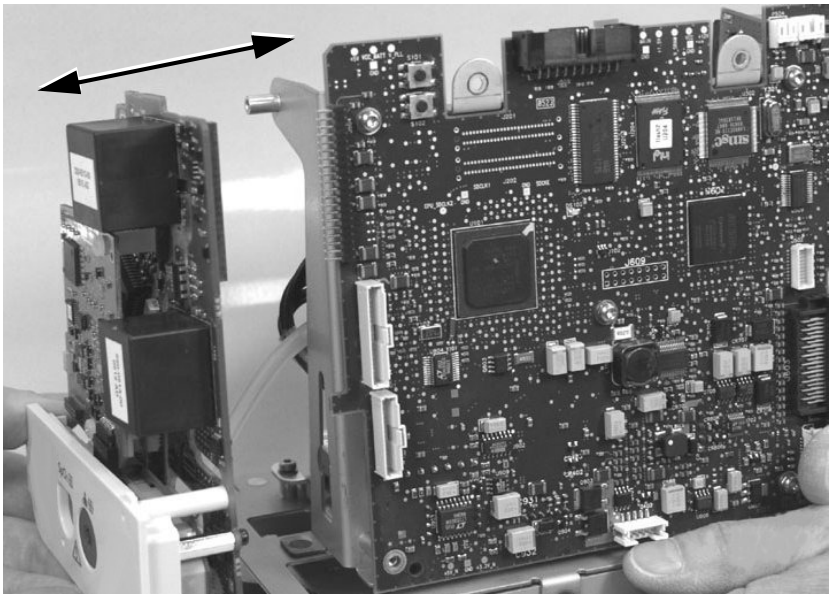
1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.

3. Turn the main PCB assembly around and disconnect the tubing from the NBP manifold.

4. Remove the two Torx T10 screws and washers holding the front end assembly to the main PCB assembly metal case.



5. Pull the front end assembly away from the 40-pin connector on the side of the main PCB board.

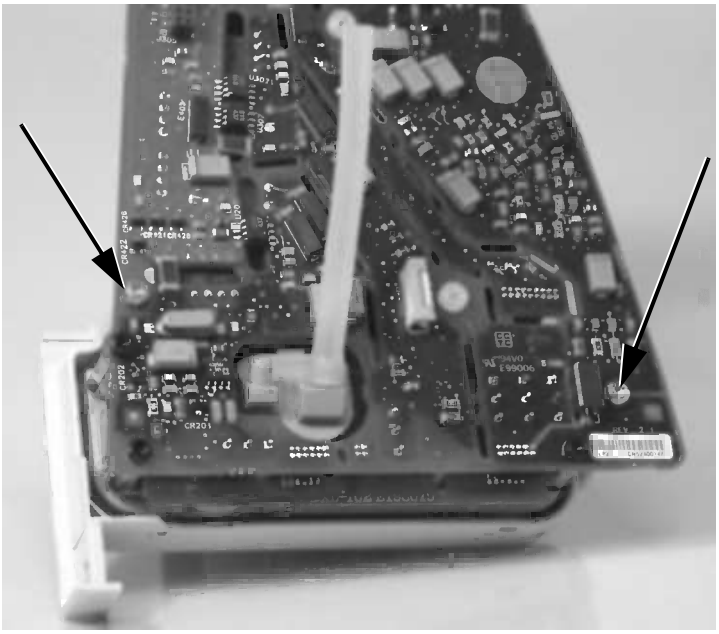


Removing the Front End Assembly Cover

To remove the front end assembly cover:

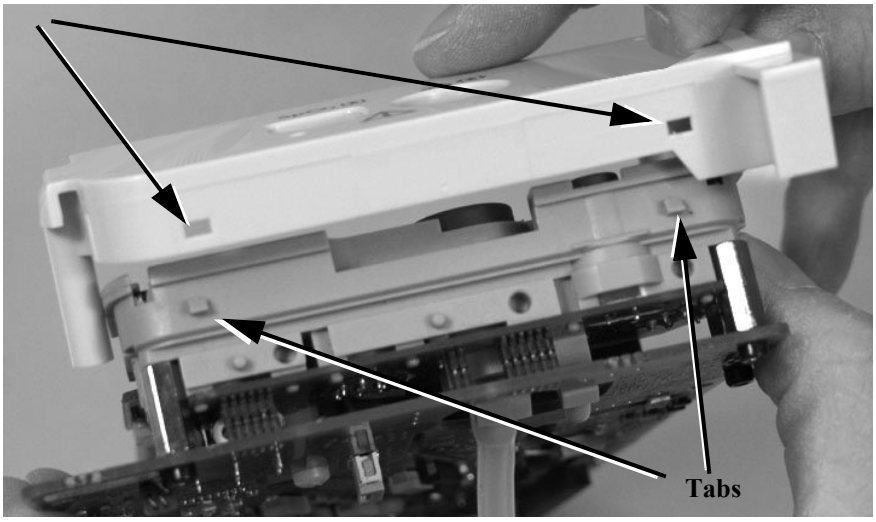
1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.
3. Remove the front end assembly. See “Removing the Front End Assembly” on page 8-21.

4. Remove the two Torx T10 screws holding the plastic cover to the front end assembly board



5. Snap the cover off of the front end assembly by inserting a small slot screwdriver into the two catches at the bottom of the cover.

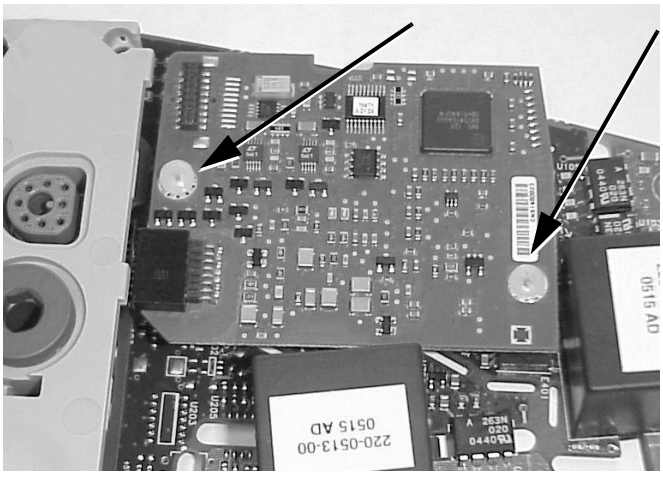
6. To reattach, line up the openings in the plastic cover with the patient connector tabs and snap the cover into place by pressing it onto the assembly.



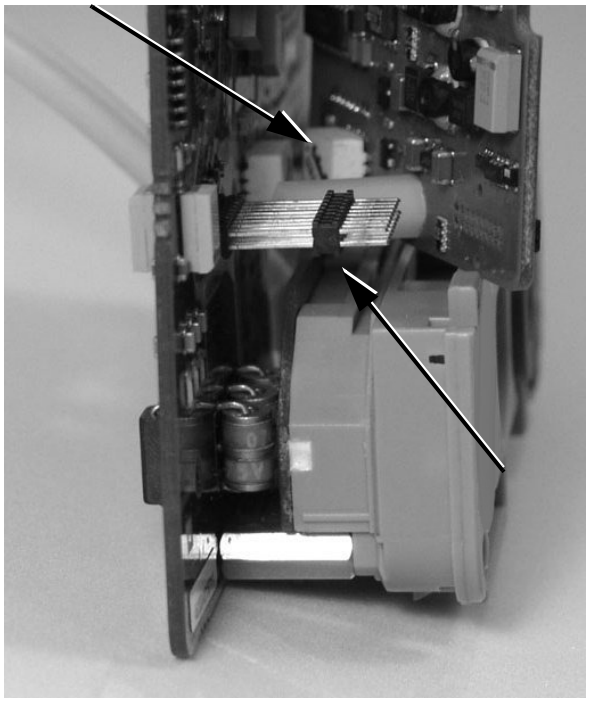
Removing the SpO_2 Board

To remove the SpO_2 board:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.
3. Remove the front end assembly. See “Removing the Front End Assembly” on page 8-21.
4. Remove the front end assembly cover. See “Removing the Front End Assembly Cover” on page 8-23.
5. Remove the two white plastic #1 Phillips-head screws on the front end assembly.



6. Remove the two connectors and separate the SpO_2 board from the front end assembly board.



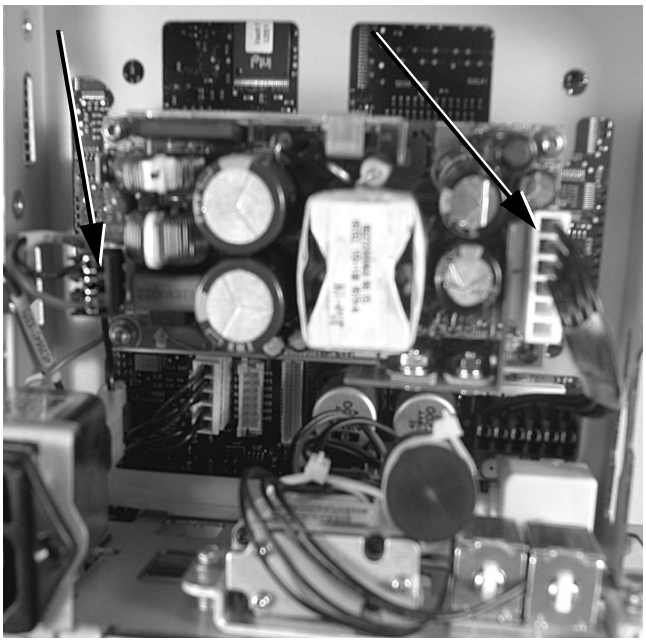
When Assembling the SpO_2 Board

1. Remove the front assembly cover (if not already removed). See “Removing the Front End Assembly Cover” on page 8-23.
2. Attach the two connectors on the SpO_2 and front end assembly boards.

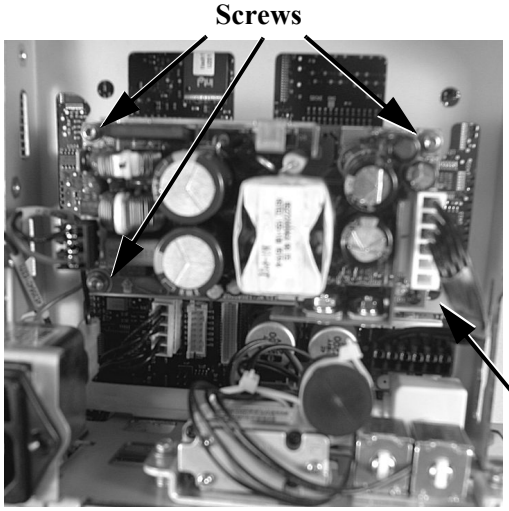
Removing the Power Supply

To remove the power supply:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.
3. Remove the 2- and 6-pin power supply connectors from the back of the main PCB assembly.



4. Remove the three Torx T10 screws and washers; use pliers to release the plastic stand-off pin; and remove the power supply from the assembly.

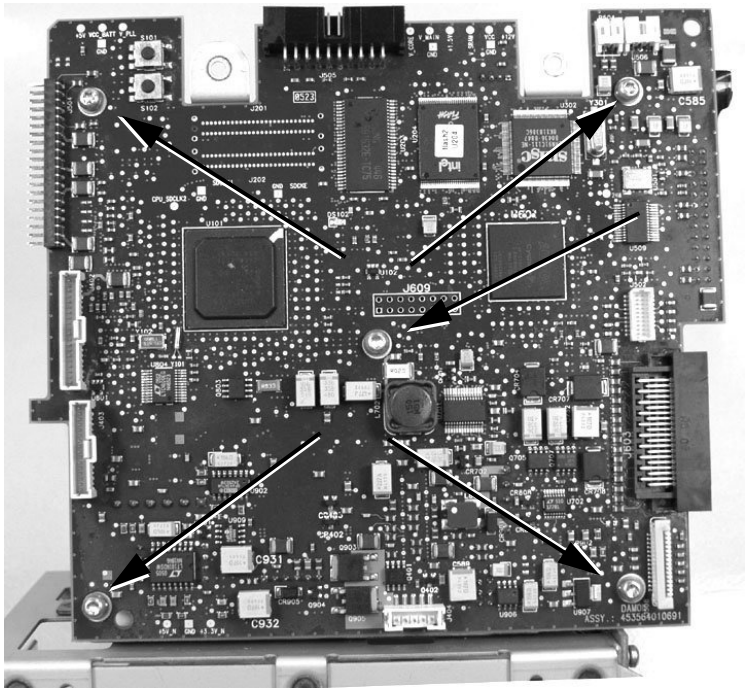


Removing the Main PCB

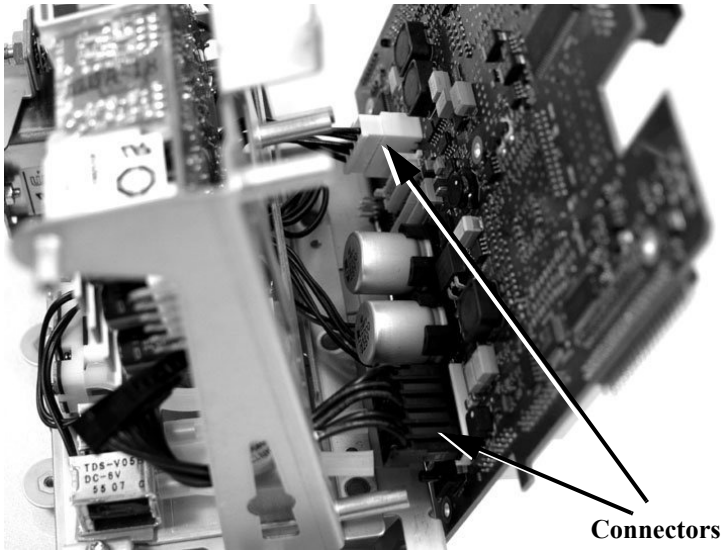
Caution **After replacing the main PCB, you must reset the monitor serial number and reconfigure the system. For information on resetting the serial number, see "Resetting a Serial Number" on page 5-14. For information on configuring the system, see "Setting the System Configuration" on page 5-15.**

To remove the main PCB:

1. Separate the front and rear monitor case assemblies. See "Separating the Front and Rear Case Assemblies" on page 8-9.
2. Remove the main PCB assembly. See "Removing the Main PCB Assembly" on page 8-13.
3. Remove the front end assembly. See "Removing the Front End Assembly" on page 8-21.
4. Remove five T10 screws holding the main PCB.



5. Remove all of the connectors and NBP tubes from the main PCB.



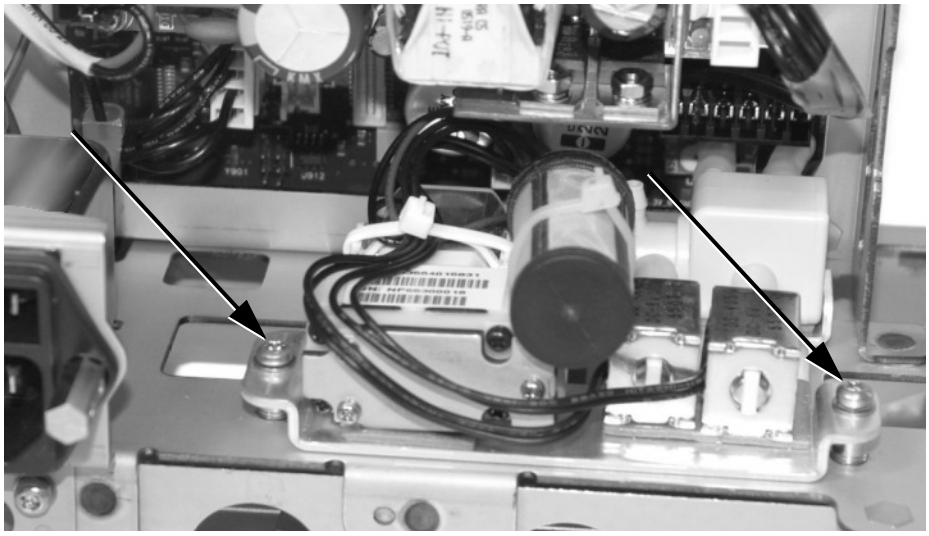
6. Remove the board from the assembly.

Removing the NBP Module

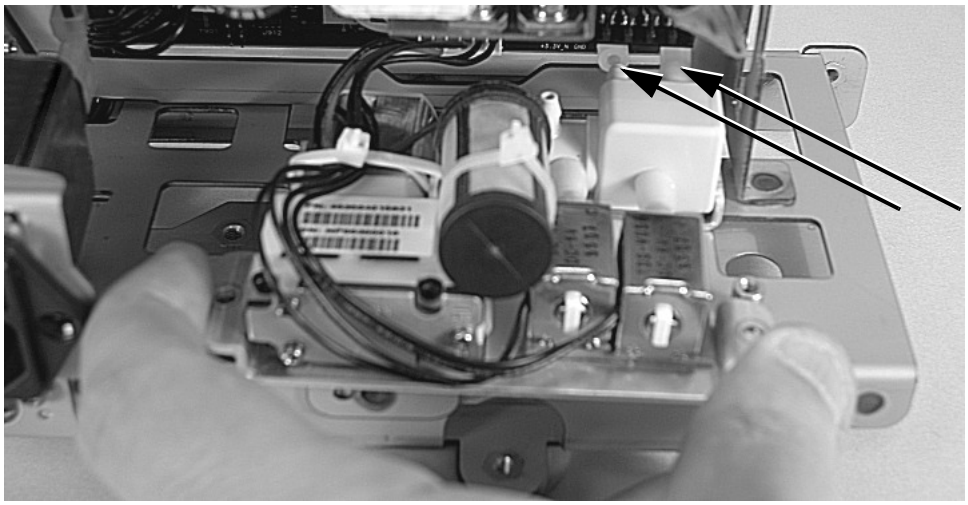
Caution **After replacing the NBP module, you must reset the NBP cycle count. For more information on resetting the NBP cycle count, see "Tracking Component Usage" on page 7-31.**

To remove the NBP module:

1. Separate the front and rear monitor case assemblies. See "Separating the Front and Rear Case Assemblies" on page 8-9
2. Remove the main PCB assembly. See "Removing the Main PCB Assembly" on page 8-13.
3. Remove the front end assembly. See "Removing the Front End Assembly" on page 8-21.
4. Remove two Torx T10 screws and washers from the metal bracket holding the NBP module assembly to the bottom of the main PCB.



5. Lift the unit and wiggle it free from the pressure sensor tube connectors.



6. Disconnect the 6-pin connector from the main PCB board and remove the NBP module.

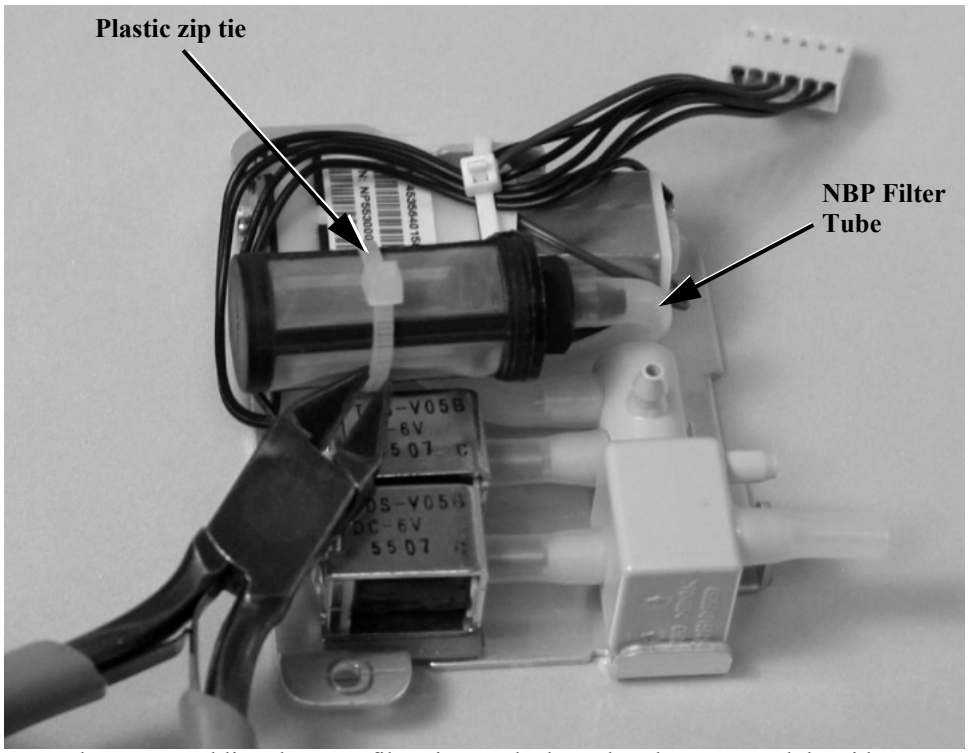
When Reinstalling the NBP Module

1. Install the main PCB first if you have removed it.

Removing the NBP Filter

To remove the NBP filter:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.
3. Remove the front end assembly. See “Removing the Front End Assembly” on page 8-21.
4. Remove the NBP module. See “Removing the NBP Module” on page 8-30.
5. Use wire-cutters to cut the plastic zip tie securing the filter to the module, and disconnect the filter from the NBP filter tube.

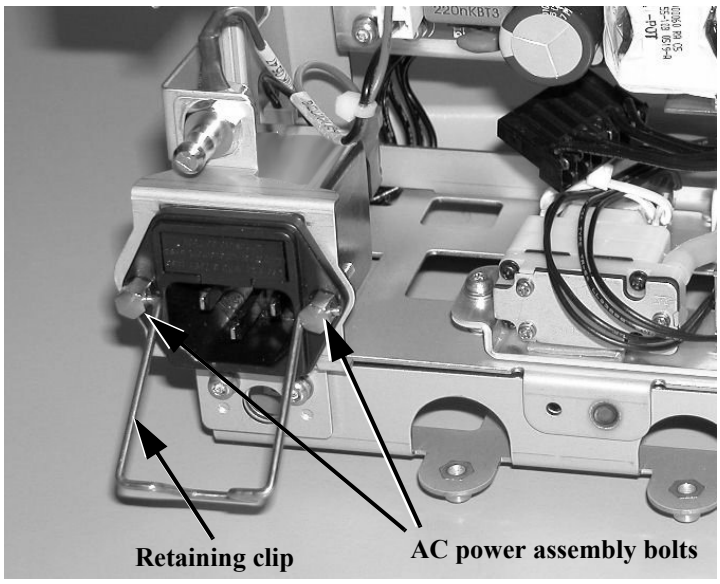


Note—When reassembling the NBP filter, it must be bound to the NBP module with a new plastic zip tie.

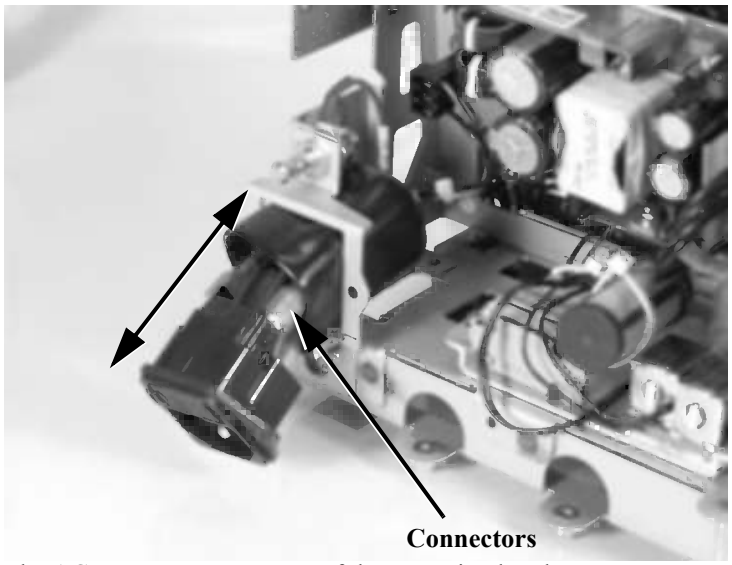
Removing the AC Power Connector

To remove the AC power connector:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9.
2. Remove the main PCB assembly. See “Removing the Main PCB” on page 8-28.
3. Squeeze the power cord retaining clip and remove it from the small holes in the two AC power assembly bolts. Remove the bolts and lock washers holding the AC power connector to the case.



4. Slide the AC power connector out of its rubber insulating sleeve, and disconnect the three connectors.

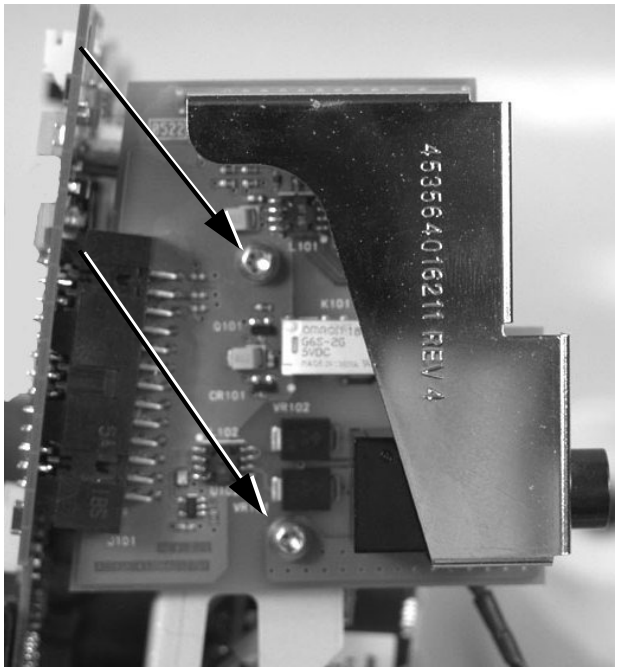


5. Slide the AC power connector out of the mounting bracket.

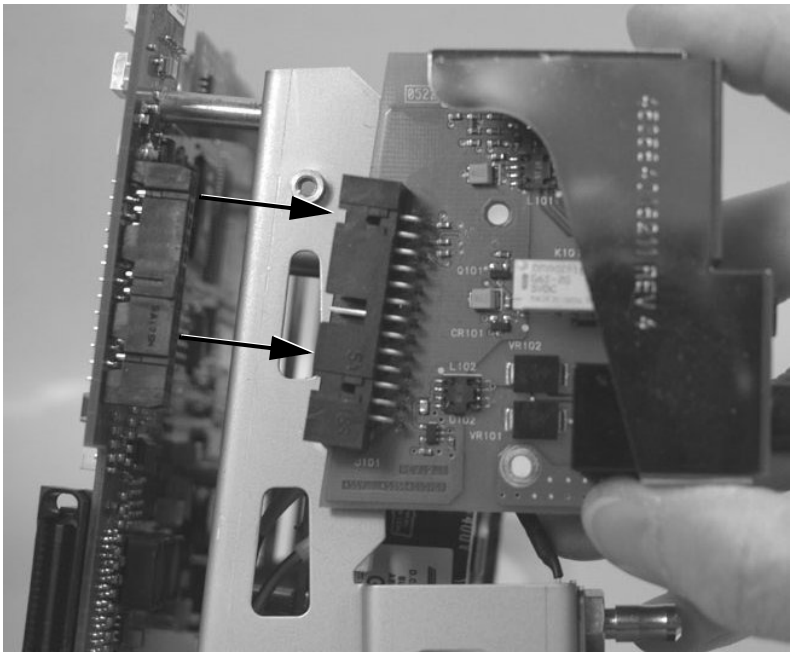
Removing the Communications (LAN) Board

To remove the communications board:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9.
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.
3. Remove two Torx T10 screws and washers holding the communications board to the main PCB assembly.



4. Pull the LAN board away from the 26-pin connector on the main PCB and remove it.

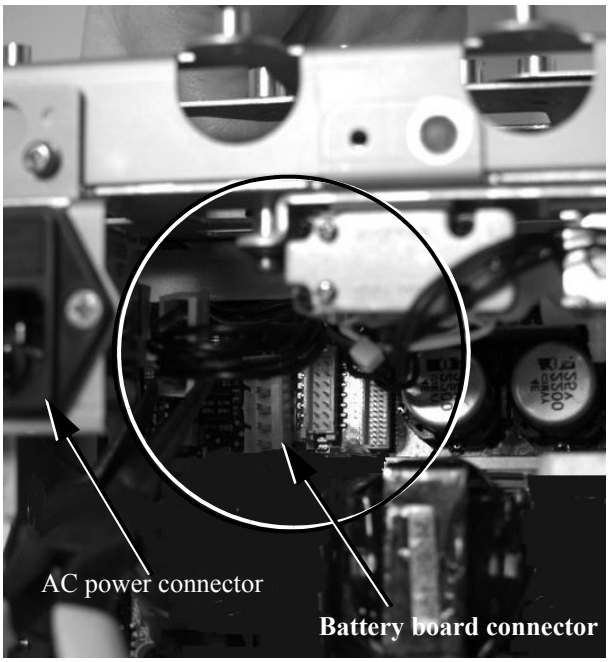


Removing the Battery Connector Board

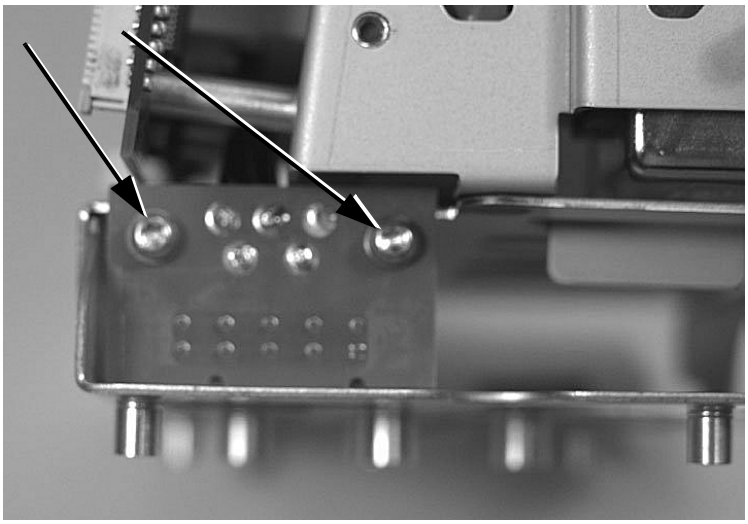
To remove the battery connector board:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9
2. Remove the main PCB assembly. See “Removing the Main PCB Assembly” on page 8-13.

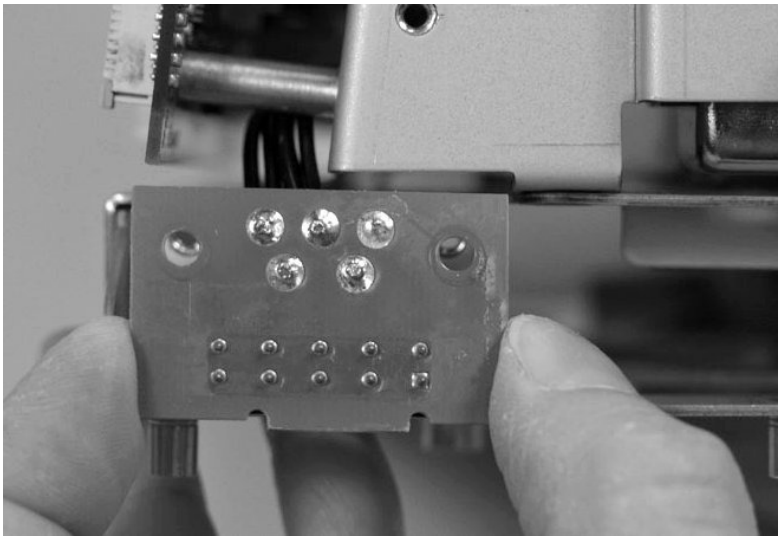
3. Disconnect the battery board connector from the main PCB on the main PCB assembly.



4. Remove two Torx T10 screws and washers holding the battery connector board.



5. Lift the board out of the slot in the metal front end assembly case and remove it.



Front Case Disassembly Procedures

This section describes how to remove items in the front case assembly. You can replace these items:

Part	Part Number
VS3 LCD assembly	4535 640 20361
Navigation wheel assembly PCB	4535 640 20381
VS3 backlight PCB	4535 640 20241
VS3 LCD backlight cable	4535 640 20281
VS3 LCD signal-in cable	4535 640 53881

See Chapter 9, *Replacement Parts and Assembly Diagrams* for a complete list (including part numbers) of spare parts.

Removing the LCD

Caution **After replacing the LCD, you must reset the LCD Usage Hours. For more information on resetting the LCD Usage Hours, see "Tracking Component Usage" on page 7-31.**

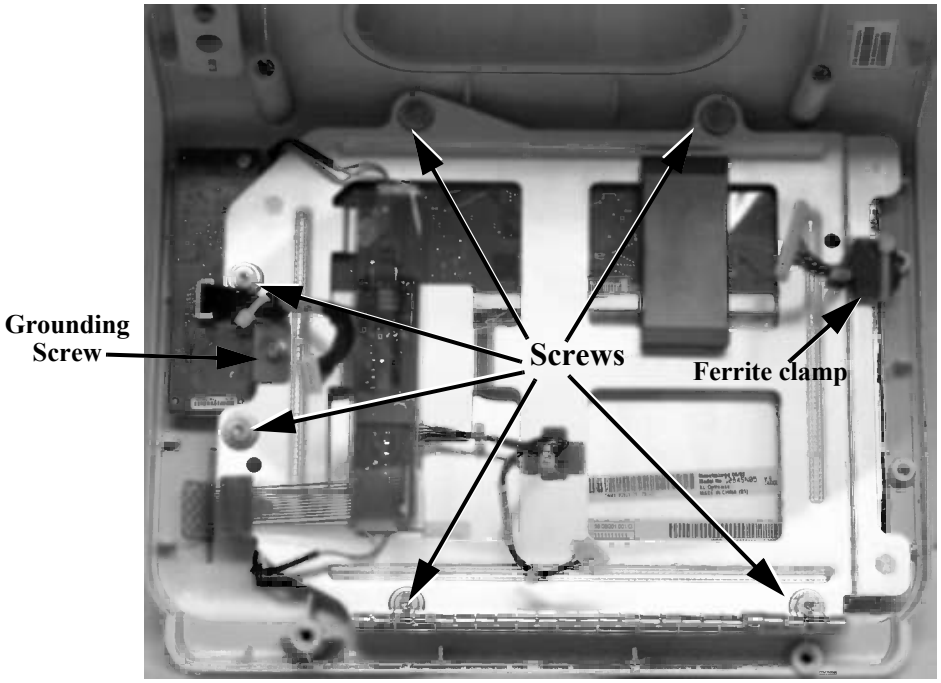
Caution **Perform this procedure in a dust-free environment to avoid damage to the LCD display.**

Note—When replacing or repairing the VS3 LCD Signal-In cable, the cable's ferrite clamp must be fixed to the display with a strip of foam adhesive, and secured with a new plastic zip tie. See photo in step 2 in the following section for placement.

To remove the LCD:

1. Separate the front and rear monitor case assemblies. See "Separating the Front and Rear Case Assemblies" on page 8-9

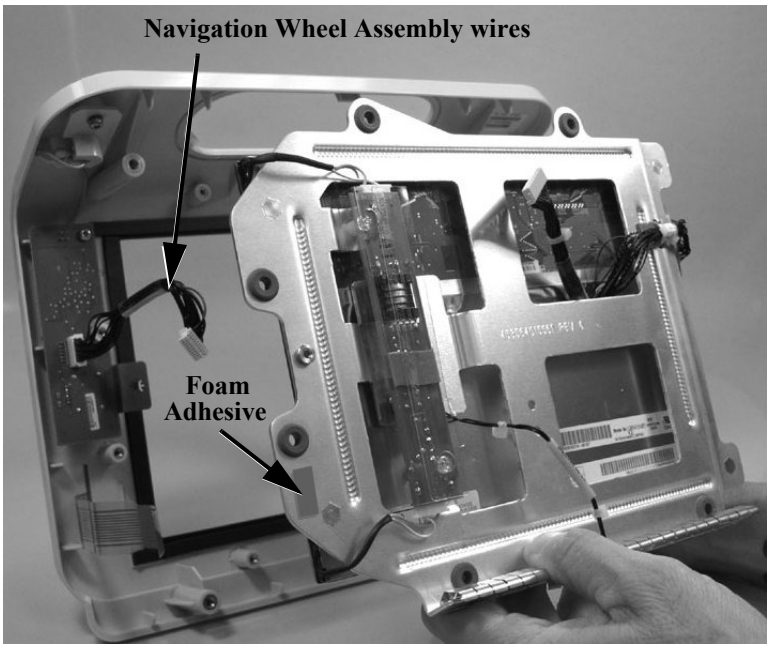
2. Remove six Torx T10 screws that hold the display in place; remove the grounding screw and washer; .



3. Use wire-cutters to cut the plastic zip tie securing the navigation wheel assembly wires to the display.

Note—When reassembling the navigation wheel and LCD assemblies, the cables should be secured to the display with a new plastic zip tie.

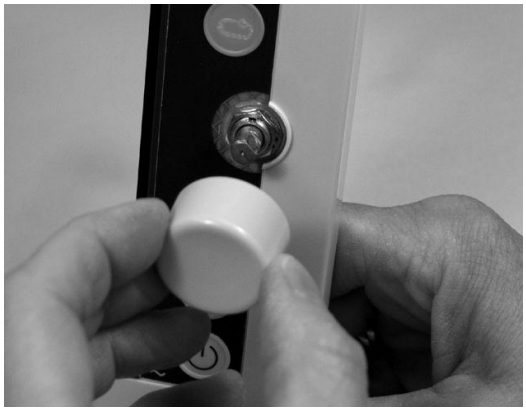
4. Gently peel the ribbon cable from the foam adhesive, and lift the display out of the front case.



Removing the Navigation Wheel Assembly Board

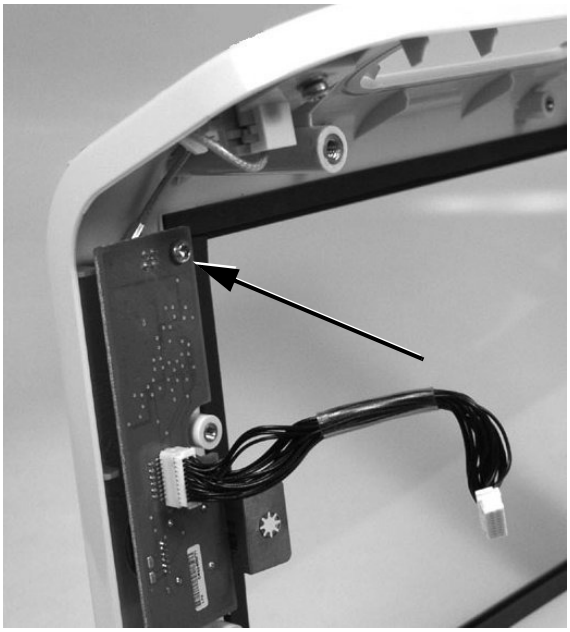
To remove the navigation wheel assembly board:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9.
2. Remove the LCD display. See “Removing the LCD” on page 8-38.
3. Pull the wheel off of the stem.



4. Remove the locking nut and washer.

5. Remove the Torx T10 self-tapping screw.



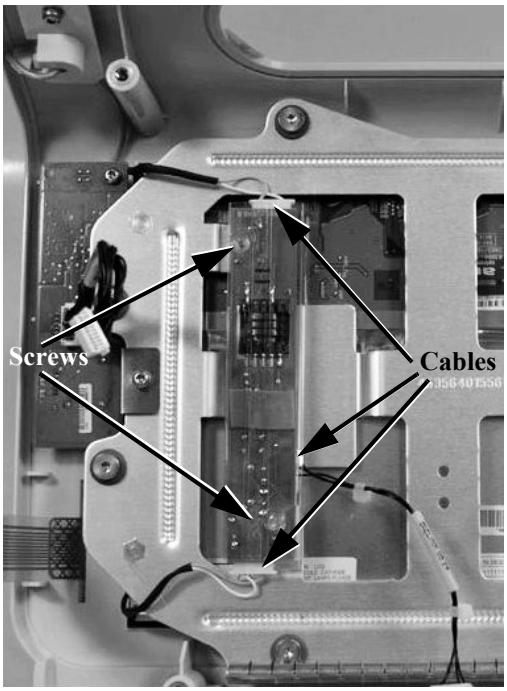
6. Press the stem while lifting off the wheel assembly.

Note—When reattaching the wheel, line up the flat side of the wheel to the flat side of the metal wheel stem.

Removing the Backlight Board

To remove the backlight board:

1. Separate the front and rear monitor case assemblies. See “Separating the Front and Rear Case Assemblies” on page 8-9.
2. Remove two Phillips head screws and the cables holding the backlight board to the LCD.



3. Pull the board away from the LCD assembly.

9
Replacement Parts and Assembly Diagrams

In This Chapter

- Spare Parts 9-2
- Power Supply Cords 9-9
- Exchange Parts 9-10

Spare Parts

The following table lists the SureSigns VS3 vital signs monitor spare parts and their Philips part numbers. See Figure 9-1 through Figure 9-5 for the item numbers that correspond to each spare part in the list.

Part Number	Description	Item
4535 640 51201	AC power input module	21
4535 640 20241	VS3 backlight PCB – LCD	9
4535 640 20261	Backpack base	13
989803144631	SureSigns monitor Lithium Ion battery	22
4535 640 20271	Battery connector PCB	11
4535 640 20281	VS3 cable – LCD backlight	6
4535 640 20291	Cable – DC in	26
4535 640 53881	VS3 LCD signal-in cable	4
4535 640 20311	Cover without recorder	14
4535 640 41431	VS3 front end assembly (NBP only)	19
4535 640 41451	VS3 front end assembly (NBP and SpO_2)	19
4535 640 20361	VS3 LCD assembly	3
4535 640 20381	Navigation wheel PCB	7
4535 640 20421	VS3 handle with O-ring	31
4535 640 41481	LAN (I/O Communications) PCB	12
4535 640 41381	VS3 Main PCB	20
4535 640 20461	NBP pump/valve assembly with filter	16
4535 640 41171	NBP filter replacement	16A
4535 640 20471	Power supply module	27
4535 640 20511	VS3 rear case	18
4535 640 20521	Recorder assembly	15
4535 640 20531	SpO_2 PCB	32
4535 640 24541	VS3 LCD frame	8
4535 640 24591	VS3 fan assembly	30
4535 640 41461	VS3 front panel without LCD	2
4535 640 24621	Main frame	10

Part Number	Description	Item
4535 640 24651	VS3 temperature module	23
4535 640 24661	VS3 temperature sheath holder	23A
4535 640 24681	VS3 speaker	29
4535 640 31241	VS3 cable – navigation wheel PCB	5
4535 640 31481	Small parts kit: – Rubber feet (4) – 1600 mA Fuses (2) – Battery case cover (1) – Navigation wheel (1) – T10 Torx screws (6) – M4 x 0.7 10 mm screws (2) – M4 x 0.7 12 mm screws (6) – D spring – Ground strip (1) – Power cord retaining clip (1) – Bedrail hook clip – USB clamp	 25 — 17 1 — — — 1A 1B 21A — —
4535 640 40811	Barcode Scanner	—

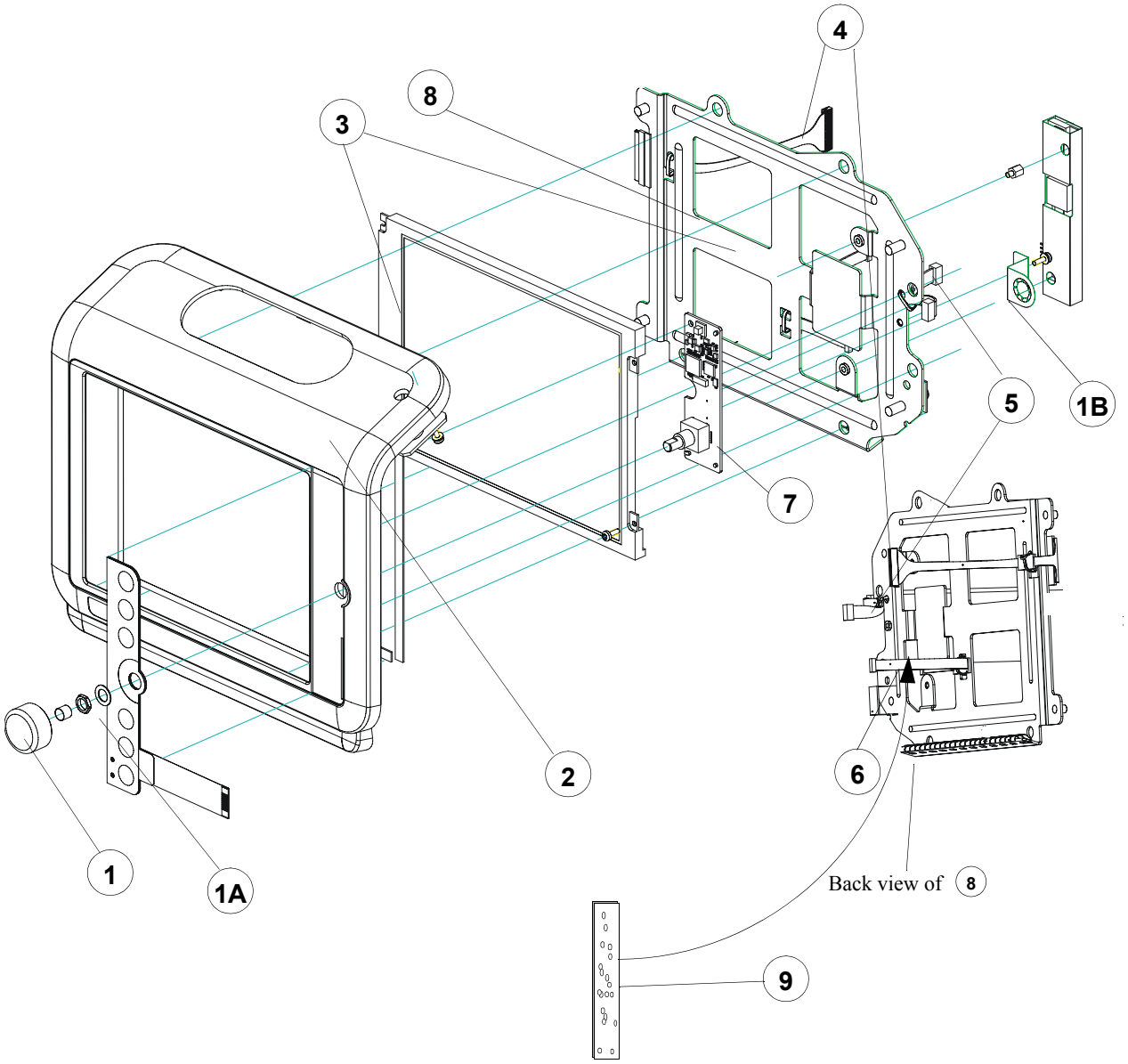


Figure 9-1 Front Case Assembly

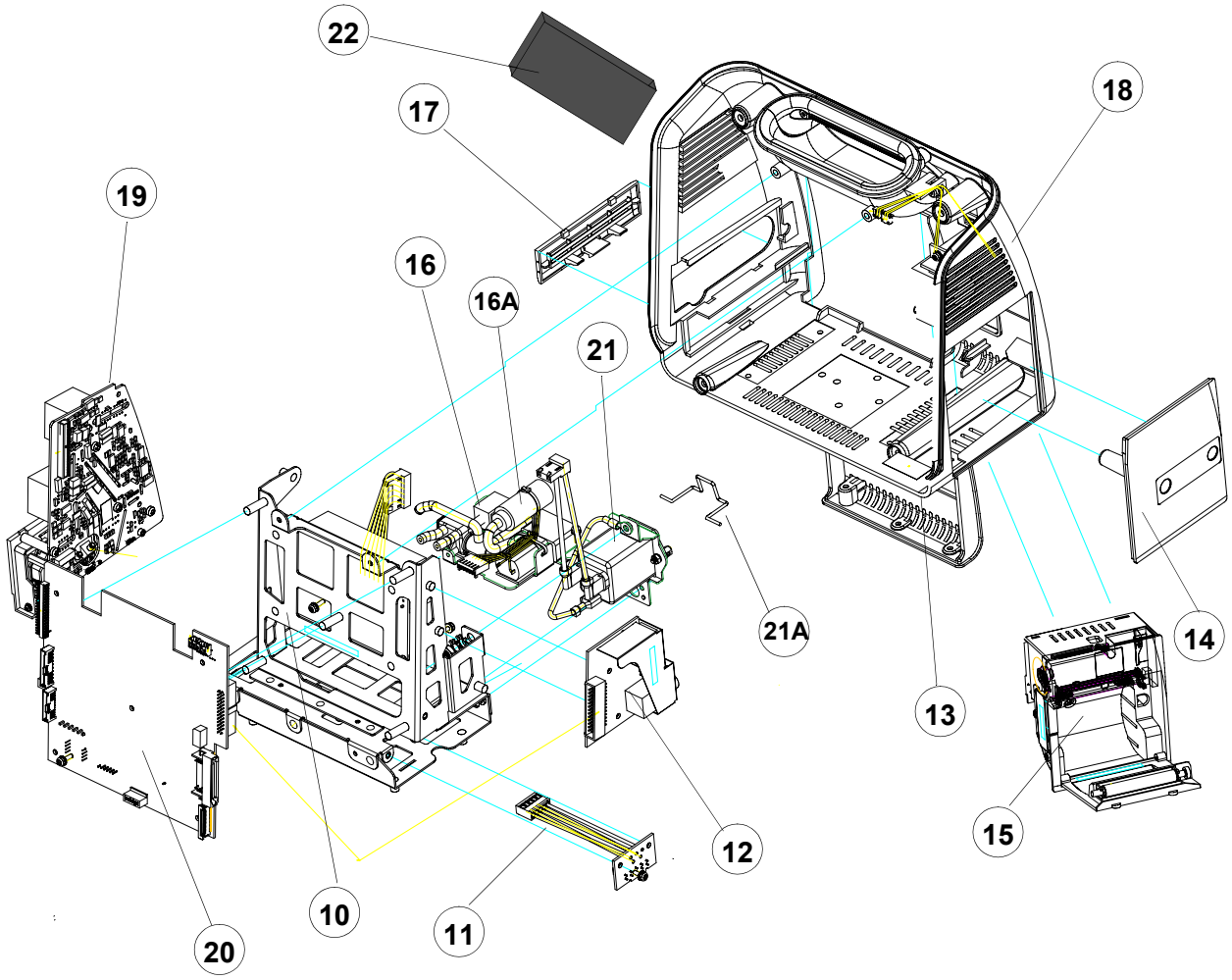


Figure 9-2 Rear Case Assembly, View 1

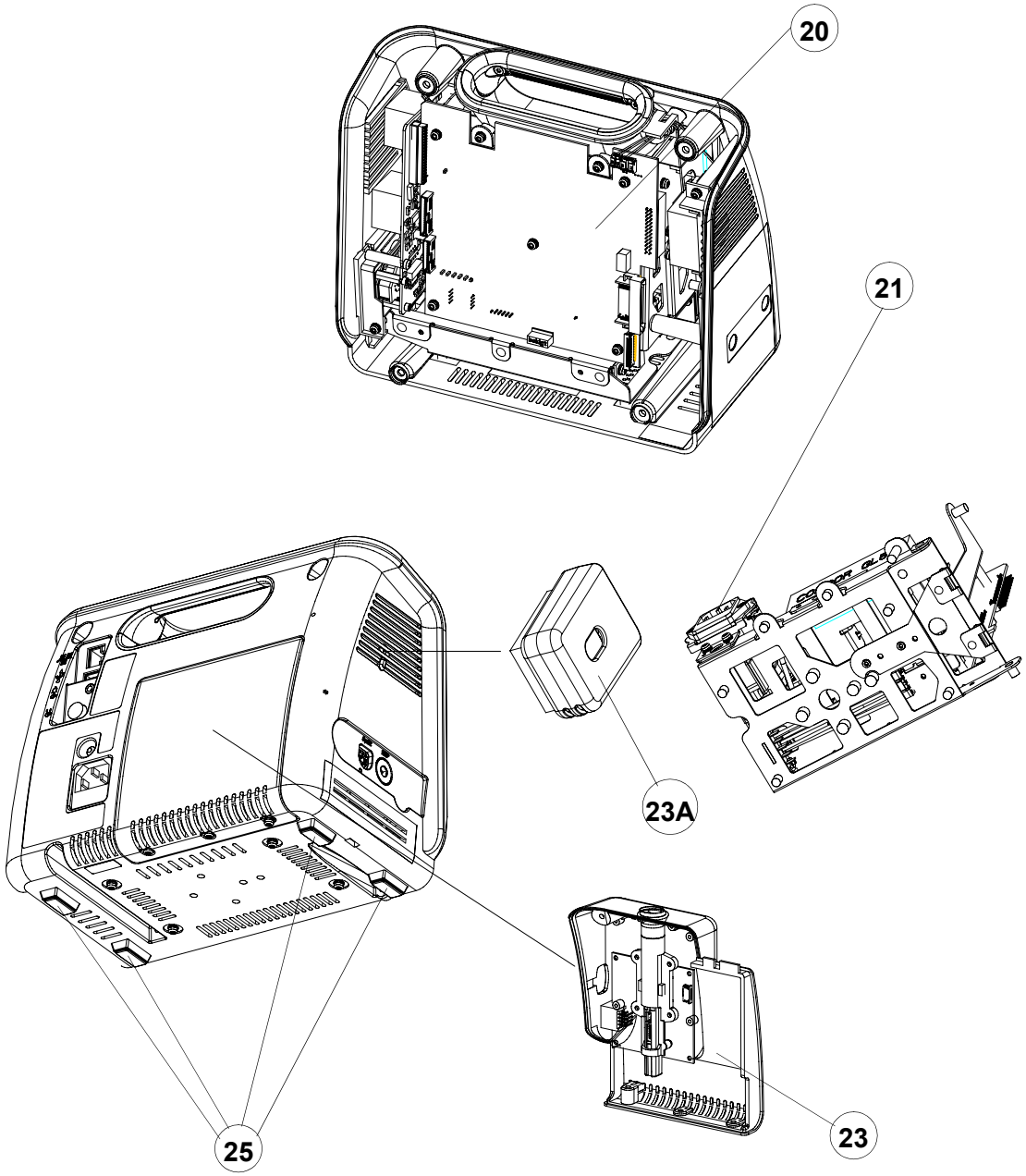


Figure 9-3 Rear Case Assembly, View 2

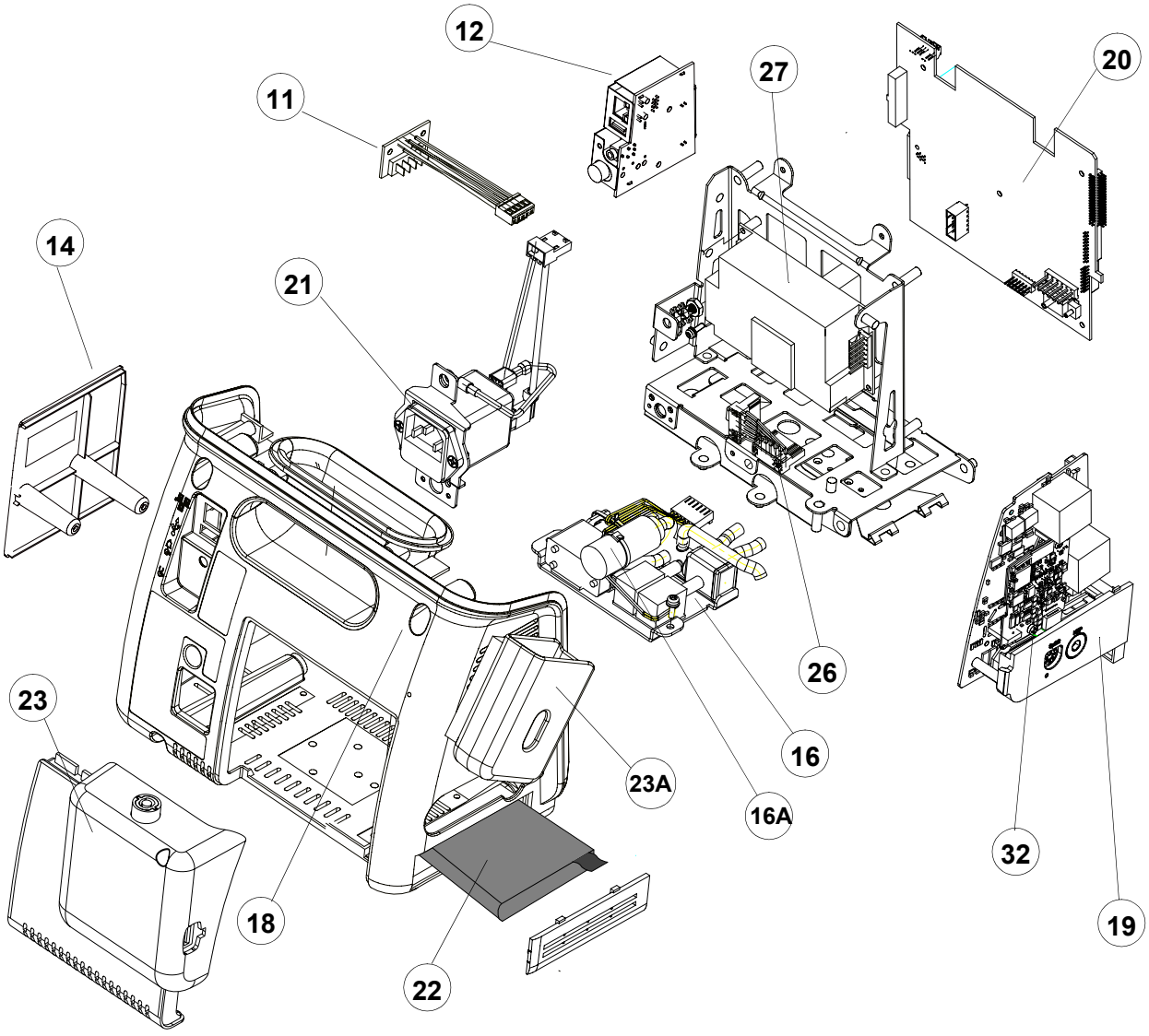


Figure 9-4 Rear Case Assembly, View 3

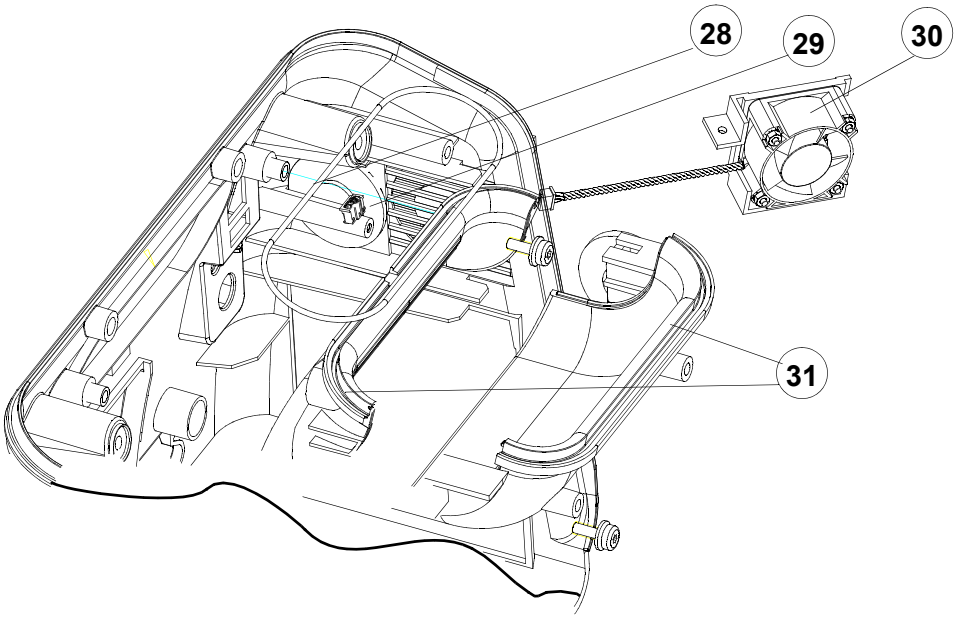


Figure 9-5 Rear Case Assembly, Top View

Power Supply Cords

The following table lists the power supply cord part number and description.

Description	Part Number
Power cord (903), 2.4 m Taiwan, US, Canada, Latin America, Singapore, Caribbean, Laos	8120-5429
Power cord (902), 2 m Portugal, Korea, Russia, South America, Indonesia, West Indies, Libya	8120-1689
Power cord (906), 2 m Switzerland	8120-2104
Power cord (917), 2 m India, South Africa	8120-4211
Power cord (901), 2 m Australia	8120-4475
Power cord (919), 2m Israel	8120-5182
Power cord (900), 2 m United Kingdom, Singapore, Hong Kong	8120-1351
Power cord (920), 2 m Europe	8120-6869
Power cord (921), 4.5 m Argentina	8120-6980

Exchange Parts

Exchange parts are parts returned to Philips and reconditioned for use. Exchange parts are in excellent condition and meet all Philips standards. These parts offer considerable price advantage.

The following table lists all parts available from the exchange unit.

Description	Exchange Part Number
SureSigns VS3 monitor	4535 640 41251
SureSigns VS3 monitor with SpO2	4535 640 41271
SureSigns VS3 monitor with SpO2 and recorder	4535 640 41281
SureSigns VS3 monitor with temperature module	4535 640 41261
SureSigns VS3 monitor with SpO2 and temperature module	4535 640 41291
SureSigns VS3 monitor with SpO2, temperature module, and recorder	4535 640 41301
SureSigns VS3 front end assembly (NBP only)	4535 640 41431
SureSigns VS3 front end assembly (NBP and SpO_2)	4535 640 41441
SureSigns VS3 main PCB	4535 640 41381

A
Theory of Operation

In This Chapter

- System Overview A-2
- Block Diagram Components A-2
- Block Diagram A-3
- Main PCB A-4
- Front End PCB A-5
- Communications (LAN) PCB A-5
- Front Panel Assembly A-6
- Speaker A-6
- Navigation Wheel A-6
- Power Supply Module A-7
- Recorder A-7
- NBP Assembly and Circuitry A-8
- SpO2 Processing A-8
- Temperature A-9

System Overview

This section contains a system overview for the SureSigns VS3 vital signs monitor, including a high-level block diagram. This block diagram shows major components of the monitor, including the power supply, isolated front end, NBP control, and SpO_2 processing, and microcontroller.

The monitor is a vital signs monitor for use on adult, pediatric, and neonatal patients.The functions performed by the system include:

- Non-invasive blood pressure
- Blood oxygen saturation
- Temperature

In addition to monitoring and displaying the status of physiological parameters, the monitor performs various microprocessor-programmed analytical functions, including:

- Creating both visual and audible alarm signals when settings are violated
- Creating and displaying warning messages when conditions are detected that would degrade or prevent valid measurements
- Creating and displaying tabular data
- Providing input to an recorder for printout of current or tabular data

The SureSigns VS3 vital signs monitor operates from either an AC power source or battery power. The monitor charges the battery when powered by an AC line.

Block Diagram Components

The SureSigns VS3 vital signs monitor contains several major blocks, including:

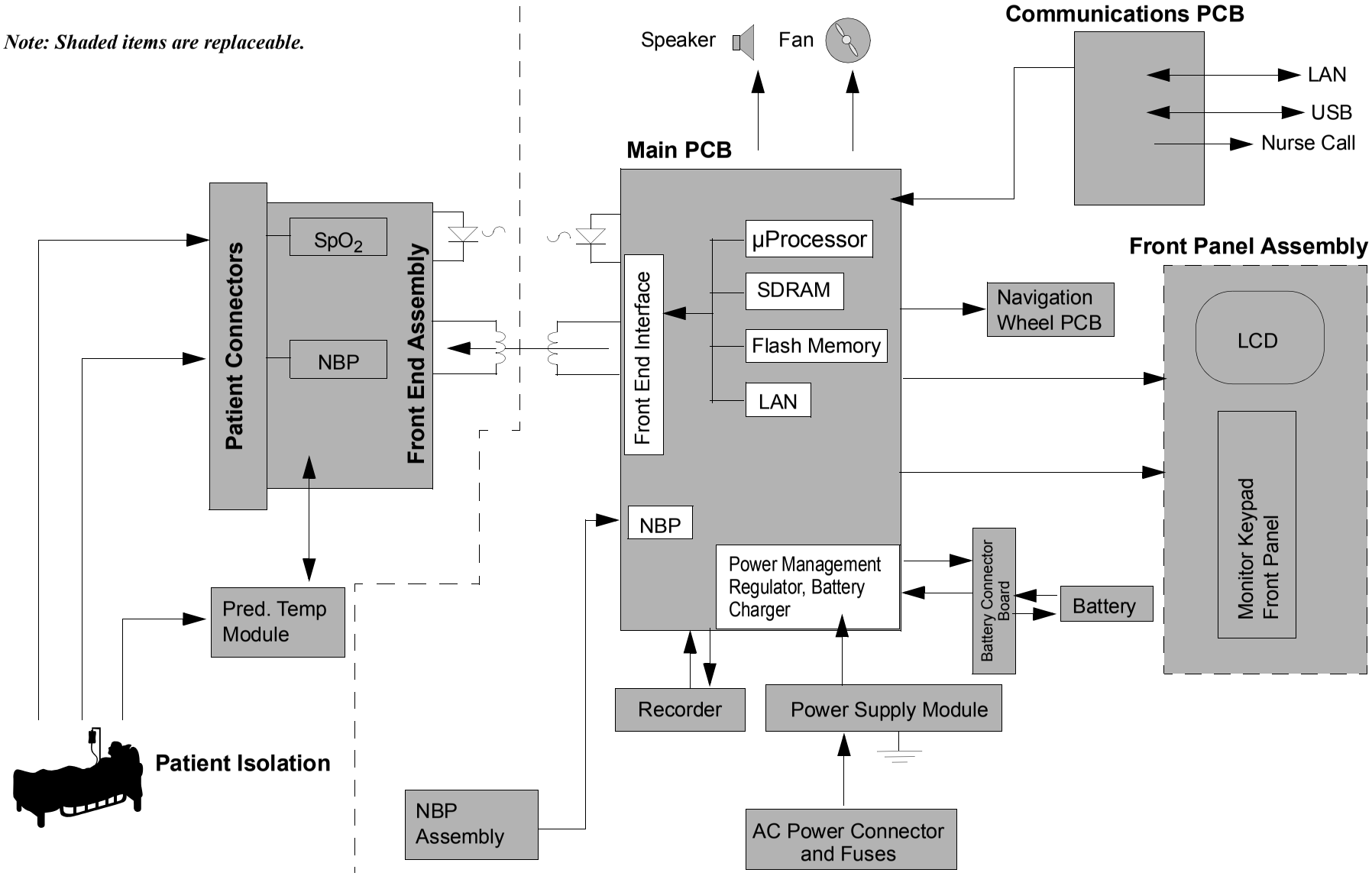
- Front end assembly
- Main PCB
- Communications PCB
- Front panel assembly

The monitor also contains several additional modules.

Note—Shaded blocks (and items) in the diagram indicate parts that are field replaceable. For more information, see Chapter 9, *Replacement Parts and Assembly Diagrams*.

Block Diagram

Note: Shaded items are replaceable.



Main PCB

The main PCB contains these components:

- Intel X_Scale µProcessor
  - 32 Mb flash memory
  - 64 Mb SDRAM
- LAN controller – 10/100T
- Power management control
  - Voltage regulator
  - Smart battery charger that monitors status of battery
- USB – 1.1 compliant
- LCD drivers
- Front end interface circuitry
- Fan control
- LVDS buffer for LCD interface
- Power distribution and monitoring
- VGA DAC
- Audio
- NBP pump control circuitry
- Connectors
  - DC input (wire to AC/DC module)
  - Speaker
  - LCD
  - LCD backlight
  - Control board
  - B2B: patient daughter board
  - B2B: VGA daughter board
  - B2B: I/O daughter board
  - B2B: recorder board

Front End PCB

The front end PCB contains circuitry for the following functional inputs:

Analog circuitry:

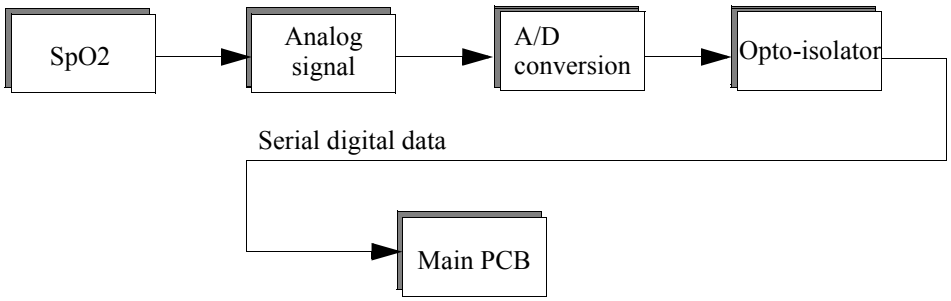
- SpO2
- Temperature

Isolation circuitry:

- Power transformers
- Opto-isolator to provide patient isolation from the monitor

In addition, the front end PCB contains a patient connector block that is soldered onto the board. The patient connector block contains B2B connector(s) to the main PCB. The patient connector block circuitry sends low-level analog measurement signals that are converted to DC, then fed (serially) to the main PCB for analysis.

For example:



Communications (LAN) PCB

The communication (LAN) PCB contains these components:

- USB connector and its EMC/ESD parts
- LAN connector and isolation transformer
- Nurse Call (alarm contact) connector and relay
- B2B connector to main PCB

Nurse Call Contacts

The nurse call alarm contacts are available through a 3.5mm, miniature insulated phone jack on the back of the unit. The alarm contacts close (open) for any alarm condition detected by the monitor.

The alarm contacts are the three switching signals associated with a single pole, double throw relay. These are the:

- Normally open contact (NO)
- Common contact
- Normally closed contact (NC)

Contact Rating of:

NO = 1A @ < 25Vac
Common contact = 1A @ < 60Vdc

Isolation of 1.5Kv

Front Panel Assembly

The front panel assembly contains these elements:

- LCD
  - 8.4” SVGA
  - 800 x 600 DPI
- Backlight PCB for LCD
- Monitor keypad
- Navigation wheel

Speaker

The speaker is driven by an amplifier and Audio CODEC that interfaces to the µProcessor. The speaker provides the monitor’s audio during alarm conditions. The µProcessor outputs different audio tones specified by different alarm priorities and conditions.

Navigation Wheel

The navigation wheel is a rotating, push-switch wheel. The associated wheel circuitry generates a pulse when pressed and generates a digitally encoded pair of quadrature signals whose relative magnitudes and polarities represent the angular position of the wheel. These outputs are connected to the µProcessor where they are interpreted as required for the functions involved. Successive angular positions determine the direction of wheel rotation. In addition to the functions performed in conjunction with the keypad, the wheel operates in conjunction with the display to select menus and lists of parameter variables.

Power Supply Module

The SureSigns VS3 vital signs monitor contains a medical grade power supply module and circuitry that converts AC lines (100-240V) to DC (15V). Power consumption is 75 VA.

Power Management

The power management module contains:

- Li + battery
  - 11.1 V
  - 7200 mAH
- Smart battery charger
- DC/DC converter

The power management circuitry charges a Li-Ion battery through a *smart* battery charger. Both the battery and the AC/DC power module can power the system through several DC/DC converters that provide various voltage outputs required by various chips. Isolated transformers provide the power to the front ends floating area.

Recorder

The recorder contains these components:

- Digital thermal head array assembly
- Printing width
  - 48mm on 58mm paper
  - Resolution:
    Time axis = 16 dots/mm at the speed of ≤25mm/sec, 8 dots/mm at 50 mm/sec
    Voltage axis = 8 dots/mm
- Motor (paper drive) and driver circuitry
- Paper out/door open detector
- Selectable print speed
  - 6.25,12.5,25,50mm/s

Print head control logic is implemented on the main PCB. The µProcessor sends data to the recorder via a local bus.

NBP Assembly and Circuitry

The NBP assembly and circuitry contain these elements:

- Pump
- Valves (2-valve system of dump and safety valve)
- Manifold
- Filter
- Pressure measurement and control circuitry

Pressure data is converted to digital format and conveyed to the processor. The NBP pump uses an oscillometric method that employs stepwise pressure deflation. Pump software eliminates most ambient noise and motion interference. Applications are neonatal, pediatric and adult patients. The blood pressure range is: Systolic, 30-255 mmHg and Diastolic, 15-220 mmHg. Accuracy is ±5 mmHg, with standard deviation no greater than 8 mmHg.

NBP processing uses an oscillometric technique to provide needed measurements at selected intervals. This technique uses an inflatable sphygmomanometer cuff similar to those used by clinicians in routine measurements.A motorized pump inflates the cuff to approximately 160 mmHg (adult mode) initially, at which point the pressure effectively stops the flow of blood. Then, under monitor control, the pressure in the cuff is gradually reduced, while a pressure transducer detects the pressure and transmits the parameter signal to the NBP input circuitry.As the pressure is reduced, blood flows in the previously occluded artery, and changes the measurements made by the transducer. The point at which oscillation increases sharply is defined as systolic pressure. As the cuff continues to deflate, the oscillation amplitude increases to a maximum, and then decreases. The peak oscillation amplitude is defined as the mean arterial pressure. The point at which the system detects a rapid decrease in oscillation is defined as the diastolic pressure.

SpO_2 Processing

SpO_2 is a measurement of oxygen saturation in the blood that uses an optical spectrophotometry technique. It is based on the differences in the absorption of red and Infrared light by oxygenated and de-oxygenated Hemoglobin.

A pulse oximeter passes red and infrared light into an arteriolar bed and measures changes in light absorption during the pulsatile cycle. The light sources are red and infrared light emitting diodes (LEDs). A photo diode provides detection.

To identify the oxygen saturation of arterial hemoglobin, the SureSigns VS3 vital signs monitor uses the pulsatile nature of arterial flow. During systole, a new pulse of arterial blood enters the vacuolar bed, and both blood volume and light absorption increase. During diastole, blood volume and light absorption reach their lowest point. The measurement is based on the difference between maximum and minimum absorption, focusing on the pulsatile arterial blood. In addition to the oximetry function, the measurement can also provide the heart rate.

Temperature

The SureTemp® Temperature module is a fully integrated µProcessor-based thermistor thermometer that takes oral, axillary, and rectal temperatures for all patient populations.

The monitor provides two types of temperature measurement:

- Predictive
- Monitored

Predictive Measurements

In Predictive mode, the monitor measures the patient's temperature for approximately 4 seconds for oral measurements and approximately 16 seconds for axillary and rectal measurements. The monitor then displays the final measurement.

If the monitor cannot get a reading after 1 minute, it automatically switches to Monitored mode.

Monitored Measurements

In Monitored mode, the monitor measures the patient's temperature continuously and displays the temperature in the numeric pane as long as the probe is in contact with the patient. Use Monitored mode only when a situation prevents accurate predictive measurement.

Note—Temperature measurements taken in Monitored mode are not saved to a patient record.

B
Electromagnetic Compatibility

Instructions for Use

This appendix lists the tests and compliance levels that make the SureSigns VS3 vital signs monitor suitable for use in the specified electromagnetic environment according to IEC 60601-1-2:2001.

Medical electrical equipment can either generate or receive electromagnetic interference. This product has been evaluated for electromagnetic compatibility (EMC) with the appropriate accessories according to IEC 60601-1-2:2001, the international standard for EMC for medical electrical equipment. This IEC standard has been adopted in the European Union as the European Norm, EN 60601-1-2:2001.

Radio frequency (RF) interference from nearby transmitting devices can degrade performance of the product. Electromagnetic compatibility with surrounding devices should be assessed prior to using the product.

Fixed, portable, and mobile radio frequency communications equipment can also affect the performance of medical equipment. See your service provider for assistance with the minimum recommended separation distance between RF communications equipment and the product.

The cables, sensors/transducers, and other accessories for which compliance is claimed are listed in the beginning of this manual.

Warnings

- **Use of accessories, transducers, and cables other than those specified may result in increased emissions and/or decreased immunity of the SureSigns VS3 vital signs monitor.**
- **The SureSigns VS3 vital signs monitor should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor should be observed to verify normal operation in the configuration in which it is used.**

Caution **The following ports on the SureSigns VS3 monitor are sensitive to electrostatic discharge during patient monitoring:**

- **SpO_2**
- **Temperature probe**

Follow these guidelines to reduce electrostatic discharge:

- **Do not touch the connector pins of the ports.**
- **When connecting and disconnecting cables to the ports, use ESD precautionary measures. Precautionary measures may include the following:**
  - **Make sure you are grounded prior to connection. Touch grounded metal.**
  - **Wear an ESD grounding strap and an ESD protective garment.**
  - **Provide ESD training to all users. Users should understand what electrostatic discharge is, how damage can occur, and how to prevent ESD.**

Reducing Electromagnetic Interference

The SureSigns VS3 vital signs monitor and associated accessories can be susceptible to interference from other RF energy sources and continuous, repetitive, power line bursts. Examples of other sources of RF interference are other medical electrical devices, cellular products, information technology equipment, and radio/television transmission. If interference is encountered, as demonstrated by dramatic variations in physiological parameter measurement values, attempt to locate the source. Assess the following:

- Is the interference due to misplaced or poorly applied electrodes or sensors? If so, re-apply electrodes and sensors correctly according to directions in the product's *Instructions for Use*.
- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical electrical equipment?
- Do parameter measurement values change dramatically when the AC line cord is unplugged?

Once the source is located, attempt to attenuate the interference by distancing the product from the source as much as possible. If assistance is needed, contact your local Philips representative.

Restrictions for Use

Artifact on physiological parameters caused by electromagnetic interference should be evaluated by a physician or physician authorized personnel to determine if it will negatively impact patient diagnosis or treatment.

Emissions and Immunity

The SureSigns VS3 vital signs monitor is designed and evaluated to comply with the emissions and immunity requirements of international and national EMC standards. See Tables 1 through 4 for detailed information regarding declaration and guidance.

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. See Tables 2 and 3 for this detailed immunity information. See Table 4 for recommended minimum separation distances between portable and mobile communications equipment and the product.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in system performance is a qualitative assessment which can be subjective.

Caution should, therefore, be taken in comparing immunity levels of different devices. The criteria used for degradation is not specified by the standard and can vary with the manufacturer.

Guidance and Manufacturer's Declaration

The SureSigns VS3 vital signs monitor is intended for use in the electromagnetic environment specified in the following tables. The customer or the user of the product should assure that it is used in such an environment.

Table B-1. Electromagnetic Emissions

Emissions Test	Compliance	Electromagnetic Environment Guidance
RF emissions CISPR 11	Group 1	The SureSigns VS3 vital signs monitor uses RF energy only for its internal function. Therefore, its RF emissions are very low and not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The SureSigns VS3 vital signs monitor is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Table B-2. Electromagnetic Immunity (ESD, EFT, Surge, Dips and Magnetic Field)

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 1 kV differential mode ±2 kV common mode	± 1 kV ±1 kV	In the event of reduced performance, it may be necessary to operate the patient monitor from a filtered power connection or battery powered (no electrical connection to the AC mains while monitoring.)
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV ± 2 kV	Mains power quality should be that of a typical commercial and/or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	< 5% U_T (> 95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	< 5% U_T 40% U_T 70% U_T < 5% U_T	
Power frequency (50/60 Hz) Magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Table B-3. Electromagnetic Immunity (RF Radiated and Conducted)

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the SureSigns VS3 vital signs monitor, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6	3 Vrms 0.15 to 80 MHz Outside ISM bands	3 V rms	**Recommended Separation Distance** $d = \left[\frac{3.5}{3}\right]\sqrt{P}$; 0.150 to 80 MHz
Radiated RF IEC 61000-4-3	3 V/m 80 to 2500 MHz	3 V/m	$d = \left[\frac{3.5}{3}\right]\sqrt{P}$; 80 to 800 MHz $d = \left[\frac{7}{3}\right]\sqrt{P}$; 800 to 2500 MHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[1] should be less than the compliance level in each frequency range.[2] Interference may occur in the vicinity of equipment marked with the following symbol:

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
[1] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the SureSigns VS3 vital signs monitor is used exceeds the applicable RF compliance level above, the SureSigns VS3 vital signs monitor should be observed to verify normal operation. If abnormal performance is observed, additional measures are necessary, such as re-orienting or relocating the SureSigns VS3 vital signs monitor. [2] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

Recommended Separation Distances

The SureSigns VS3 vital signs monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the product can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the product as recommended below, according to the maximum output power of the communications equipment.

Table B-4. Recommended Separation Distances Between Portable and Mobile RF Communication Equipment and the SureSigns VS3 vital signs monitor

Frequency of Transmitter	**150 kHz to 80 MHz**	**80 to 800 MHz**	**800 MHz to 2.5 GHz**
Equation	$d = \left[\frac{3.5}{3}\right]\sqrt{P}$	$d = \left[\frac{3.5}{3}\right]\sqrt{P}$	$d = \left[\frac{7}{3}\right]\sqrt{P}$
Rated Maximum Output Power of Transmitter (Watts)	**Separation Distance (d) (meters)**	**Separation Distance (d) (meters)**	**Separation Distance (d) (meters)**
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.17	1.17	2.33
10	3.69	3.69	7.38
100	11.67	11.67	23.33
For transmitters rated at a maximum output power not listed above, the separation distance *d* can be estimated, in meters, using the equation in the corresponding column, where *P* is the maximum output power rating of the transmitter in watts according to the transmitter's manufacturer. These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

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